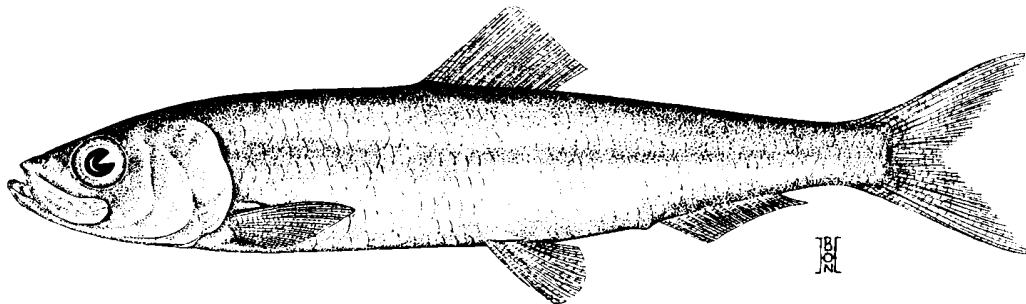


2004 Washington State Herring Stock Status Report



By

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Fish Program
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Introduction

The purpose of this report is to provide an evaluation of the current status of Pacific herring (*Clupea pallasii*) stocks in Washington. This report is the third edition published by the Washington Department of Fish and Wildlife (WDFW) that addresses the status of the herring resource in Washington waters. The previous editions are *1994 Washington State Baitfish Stock Status Report* (WDFW 1995) and *1996 Forage Fish Stock Status Report* (Lemberg et al. 1997).

Previous editions of this report have presented stock status discussions for several species classified as marine forage fish in Washington waters including: herring, surf smelt (*Hypomesus pretiosus*), Pacific sand lance (*Ammodytes hexapterus*), and northern anchovy (*Engraulis mordax*). However, this report is limited to the stock status of herring.

Forage fish in general, and herring specifically, are vital components of the marine ecosystem and are a valuable indicator of the overall health of the marine environment. Many species of sea birds, marine mammals, and finfish, including chinook (*Oncorhynchus tshawytscha*) and coho (*O. kisutch*) salmon, depend on herring as an important prey item. Significant predation occurs at each stage of the herring life cycle starting with predation on newly deposited spawn by gulls and diving ducks.

In most cases, classification of a group of fish as a stock implies that these fish are in some way different or distinct from all others, and generally implies some genetic relatedness among its members (Ihssen et al. 1981). Evidence of stock structure may be shown through differences in demographic population statistics (age composition, growth rate, fecundity, etc.), morphology (morphometrics and meristics), or genetics (differentiation at allozyme or DNA loci) (Stout et al. 2001).

This report considers each documented herring spawning ground in Washington waters to represent a discrete stock. WDFW herring assessment survey results indicate stock specific characteristics that continue to support the assumption of stock autonomy for Puget Sound herring (Trumble 1983 and O'Toole et al. 2000). Resource managers in British Columbia group their herring populations on a considerably larger scale; stock groupings consist of five assessment regions, one of which is the entire Strait of Georgia (Schweigert 2004). In their recent status review of Puget Sound herring the National Marine Fisheries Service concluded that local populations are the appropriate scale for fisheries management activities for Puget Sound herring (Stout et al. 2001).

Microsatellite DNA studies conducted by WDFW suggest that the Cherry Point stock is distinct from other sampled Puget Sound stocks. Other sampled Puget Sound stocks were not demonstrated to be genetically distinct from each other (Small et al. 2004). Recent analyses of herring microsatellite DNA variation also suggests that the Cherry Point herring stock is genetically distinct from other examined British Columbia herring populations (Beacham et al. 2002).

The stock assessment methodologies and criteria for evaluating the status of herring stocks in this report are generally similar to the first and second editions. The current sampling design for

Washington herring stocks calls for annual assessment of each stock to provide an estimate of spawning biomass. Spawning herring populations in Wollochet Bay (south Puget Sound) and southern Grays Harbor on the Washington coast have been documented since the publication of the previous edition of this report. Puget Sound herring stocks are cumulatively considerably larger than coastal stocks and have received significantly more sampling effort than coastal stocks.

For management purposes, Puget Sound is divided into three areas: south/central Puget Sound; north Puget Sound; and Strait of Juan de Fuca. Stock profiles, which include spawning information, annual run size estimates, and age and survival data are presented for each known stock within these management areas. The definitions for stock profile criteria follow this section.

Following the Puget Sound stock status profiles, stock status summaries for 1994, 1996, 1998, 2000, 2002, and 2004 are provided and are followed by a discussion and graph of cumulative herring spawner biomass estimates for the 1975-2004 period.

A section discussing annual natural mortality for adult herring within Puget Sound is presented. Herring typically mature during the second or third year and recruit to the spawning population at that time. Although herring have been reported to live as long as fifteen years, relatively few currently survive longer than age 5 or 6 in Puget Sound. Stock assessment results indicate a general increase in natural mortality for Puget Sound herring since the 1970s.

A summary of Puget Sound herring fisheries and landing information is provided in the next section. Herring were included in the 1974 "Boldt Decision" defining Native American fishing rights, and Washington stocks and fisheries are jointly co-managed statewide by WDFW and locally by area Tribal governments.

The final section gives a synopsis for coastal herring. Stock profiles for Willapa Bay and Grays Harbor (spawning activity first documented in 1998) are included.

An appendix containing herring age composition summaries is included. Estimated spawning biomass (tons) and number of fish at age are reported. Estimates are calculated from acoustic/trawl surveys.

Stock Profile Parameters

The parameters used to develop each profile are described below. Specific status ratings for each stock take into account all measurable factors available but are weighted toward spawning biomass average and trend, recruitment, and annual survival.

Stock Definition

Herring currently spawn at twenty-one sites or grounds throughout Washington waters each year. The nineteen documented Puget Sound basin spawning areas are shown in the chart on page seven. For this report, each spawning ground is considered to represent a discrete stock. This assumption is based in part on early meristic studies, which concluded that heterogeneity exists among herring samples taken from various spawning areas throughout Puget Sound (Chapman et al. 1941). Recent genetic studies have suggested that the Cherry Point herring stock is genetically distinct from other Washington and British Columbia stocks (Beacham et al. 2002 and Small et al. 2004). Genetic distinction between other sampled Puget Sound stocks has not been demonstrated (Small et al. 2004).

In addition, WDFW assessment survey results indicate stock specific characteristics such as different growth characteristics, distinctive spawning location and timing, and pre-spawner holding area behavior, which continue to support the assumption of stock autonomy for Puget Sound herring (Trumble 1983 and O'Toole 2000). Stock based assessment data are very useful for localized fisheries management issues and plans. The development of long range plans and resource assessment strategies is dependent on more widespread regional herring abundance trends.

Overview

Overview provides any unique information about or characteristics of the stock.

Spawning Ground

The **Spawning Ground** chart defines the total documented spawning ground for each stock. Herring deposit transparent, adhesive eggs primarily on lower intertidal and shallow subtidal eelgrass and marine algae. In Washington most spawning activity takes place between 0 and -10 feet MLLW in tidal elevation.

Pre-Spawner Holding Area

On each chart **Pre-Spawner Holding Area** depicts the location usually adjacent to the spawning ground in deeper waters where ripening adult herring congregate and hold prior to spawning. Schools of pre-spawning adults typically begin concentrating three to four weeks before the first spawning event (Trumble et al. 1982).

Spawning Timing

Spawning Timing for herring in Washington lasts from late January through early June, with each stock generally spawning for approximately a 2-month period. The spawning timing figure for each stock indicates the occurrence of any documented spawning activity within the first or second half of a month.

Length Data

The **Length Data** such as mean length-at-age and other basic growth data can provide additional evidence for stock separation. For example, some faster growing stocks are more likely to have an annual migration from inshore spawning grounds to more productive open ocean feeding areas, while other slower growing stocks might be more “resident,” remaining inside the Puget Sound basin year round. Mean standard length at age for age 2, 3, 4, and 5 herring are reported for the 2004 spawning season or the most recent year data were available.

Spawning Biomass

Spawning Biomass is the term used to quantify the tonnage of spawner herring abundance. Two methods are used to provide quantitative estimates of herring abundance; spawn deposition surveys and acoustic/trawl surveys (Burton 1991). Prior to 1996, the spawning biomass for the 10-12 larger Puget Sound stocks typically was assessed by both methods each year while the smaller 6-8 stocks were surveyed by spawn deposition surveys on a 3-year rotational basis. Since 1996, duplicate assessment coverage has been reduced and assessment for all known herring stocks is attempted each year by either one or both methods. If both methods are utilized, the spawn deposition estimate is used as the final run size estimate. Final spawning biomass estimates include any directed spawner fishery harvest not accounted for in the surveys. The two assessment techniques have generally shown good correspondence (Burton 1991). The years when significant variance occurs are usually associated with sampling related problems such as survey timing, adverse weather, equipment malfunctions, etc.

Spawn Deposition Surveys

Spawn Deposition Surveys provide a direct estimate of herring spawning biomass. Marine vegetation on spawning grounds is sampled for location of spawn deposition and spawn density, and those data are converted to an estimate of spawning escapement (Stick 1994). These surveys are generally conducted weekly during a stock’s spawning season to document cumulative spawn deposition.

Acoustic/Trawl Surveys

Acoustic/Trawl Surveys are conducted on the pre-spawner holding areas early in the spawning season when pre-spawner abundance is peaking. This method utilizes computer interfaced echosounding equipment that produces real-time estimates of total fish abundance, which are apportioned to herring biomass based on trawl catch data (Lemberg et al. 1990). The weighted

data from all trawl samples for each stock are pooled and extrapolated to the final run size estimate from spawn deposition surveys, when available. The resulting data set represents the age composition for the entire spawning run. Analyses of the trawl caught samples provide the basis for detailed stock indices such as biomass age composition, annual survival rates, and recruitment (O'Toole 1993).

Recruitment

Recruitment is an estimate of the biomass of new spawners in a particular year. New recruits consist of 2-year old spawners plus the calculated biomass of 3-year old spawners that spawned for the first time.

Annual Survival

The **Annual Survival** rate is the estimated percentage of spawning herring (age 3 and older) in a particular year that survived to spawn again in the following year.

Biomass Age Composition

Biomass Age Composition of the current year's spawning run is estimated from acoustic/trawl data when such data are available.

Spawner Fishery

Spawner Fishery summarizes adult (spawner) harvests. Potential adult herring fisheries in the past decade have been limited to the Cherry Point stock (the commercial product is roe). No harvest has been allowed there since 1996 due to low spawning biomass abundance. The fishing methods used are spawn-on-kelp and sac-roe. The spawn-on-kelp fishery places purse seine captured ripe herring into floating pens hung with lines of large bladed brown kelp (*Macrocystis integrifolia*). The herring spawn on the kelp, are then released, and the spawn-laden kelp is harvested. A variation of this fishery consists of hanging kelp from floating lines near the spawning beaches where it is spawned upon naturally, then harvested. The sac-roe herring are gill net caught and the ovaries are stripped from the fish and processed. The fisheries are regulated by stock abundance, area, season, and gear type.

Data Quality

Data Quality - Determined by the relative amount of stock assessment data.

Good - A continuous time series of acoustic-trawl data and spawn deposition data.

Fair - A continuous time series of spawn deposition data only.

Poor - An incomplete time series of either type of stock assessment data.

Recent Trend

Recent Trend - Slope of the regression for the most recent five years of spawning biomass estimates.

Increasing - Statistically significant positive slope (95% confidence level).

Stable - Slope not statistically significant.

Decreasing - Statistically significant negative slope.

Stock Status

Describes a stock's current condition based primarily on recent abundance (spawning biomass) compared to long-term mean abundance. Stock criteria such as survival, recruitment, age composition, and spawning ground habitat condition are also considered.

Healthy - A stock with recent 2-year mean abundance above or within 10% of the *25 year mean (1980-2004).

Moderately Healthy - A stock with recent 2-year mean abundance within 30% of the *25 year mean, and/or with high dependence on recruitment.

Depressed - A stock with recent abundance well below the long-term mean, but not so low that permanent damage to the stock is likely (i.e., recruitment failure).

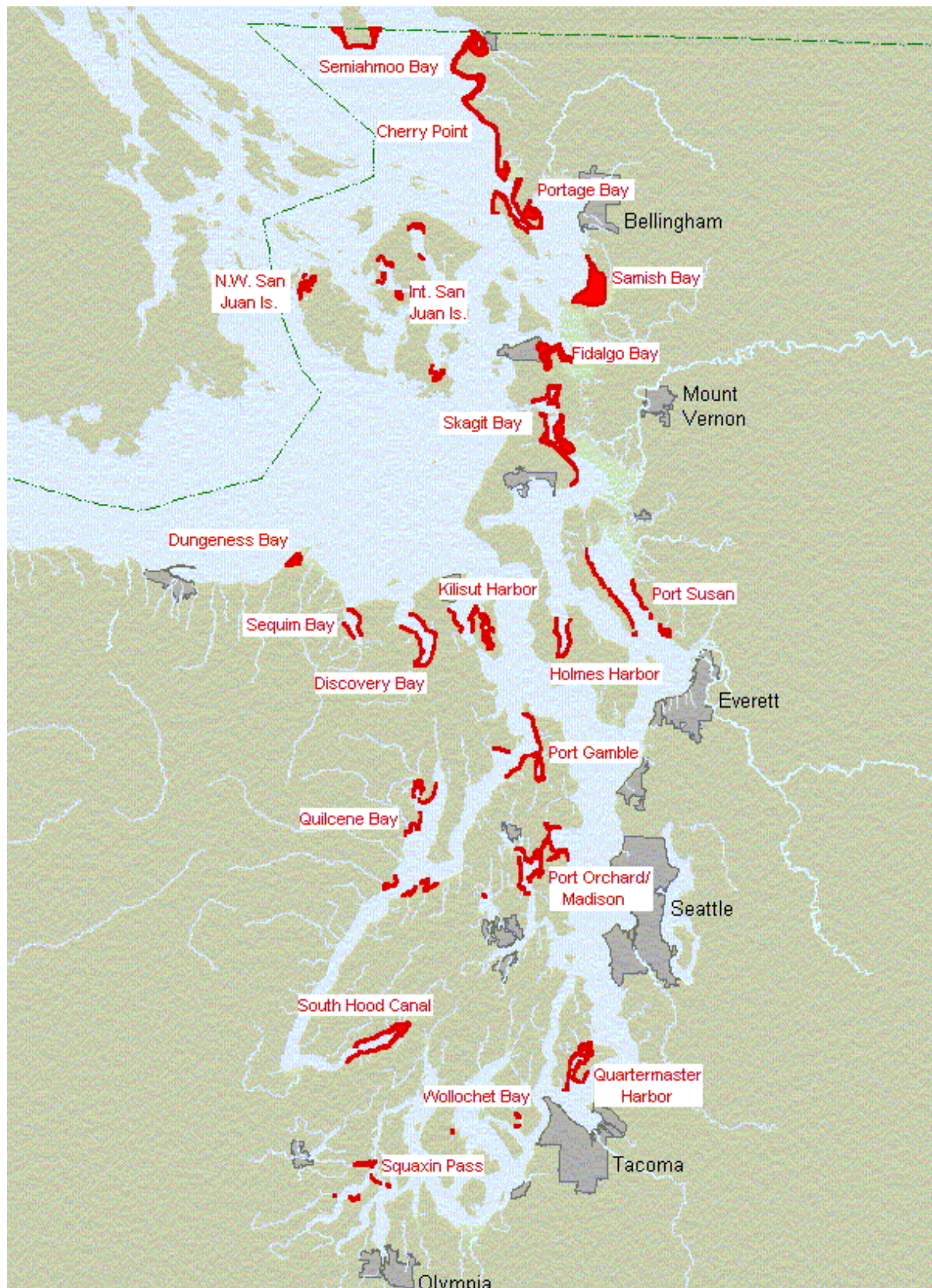
Critical - A stock with recent abundance so low that permanent damage to the stock is likely or has already occurred (i.e., recruitment failure).

Extinct - A stock that can no longer be found in a formerly consistently utilized spawning ground.

Insufficient Data - Insufficient assessment data to identify stock status with confidence.

*Previous stock status designations for 1994, 1996, 1998, and 2000 used the previous 20 year mean spawning biomass for comparison; the 25 year mean was used for the 2002 and 2004 stock status summary.

Documented Puget Sound Herring Spawning Grounds



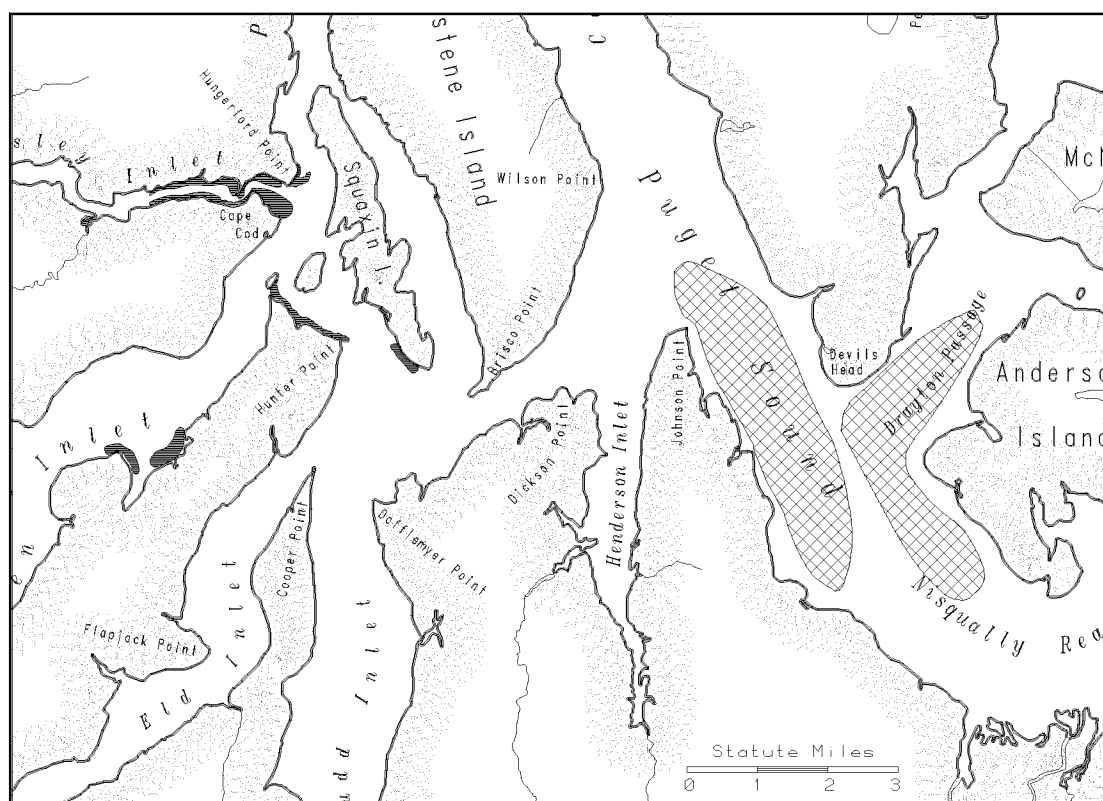
South/Central Puget Sound Herring Stock Profiles

Squaxin Pass Herring Stock

OVERVIEW

The Squaxin Pass herring, the southernmost stock within the Puget Sound basin, exhibit unusual spawning behavior. The marine algae normally utilized for spawning substrate by herring are sparse in this area. Therefore, spawn deposition often occurs on rocks and gravel, occasionally quite deep. Such behavior does not lend itself well to assessment from the spawn deposition survey methods, which may explain the large differences between the spawn deposition and acoustic/trawl survey estimates for this stock. Undocumented spawning grounds are probable for this stock. The Squaxin Pass stock has the slowest known herring growth rate in Washington. It has been at a high level of abundance in recent years.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

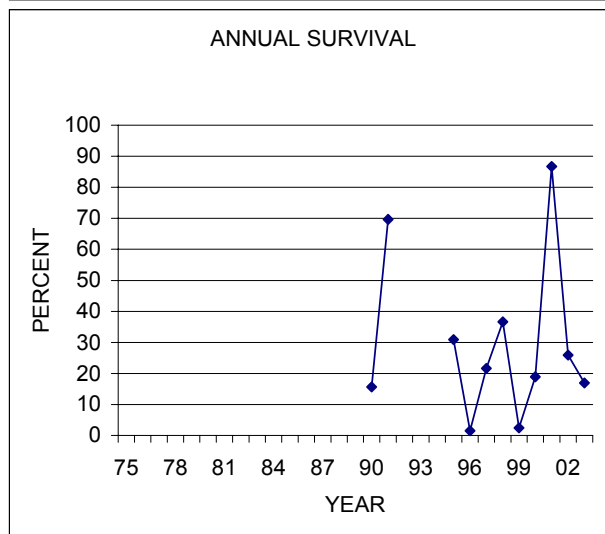
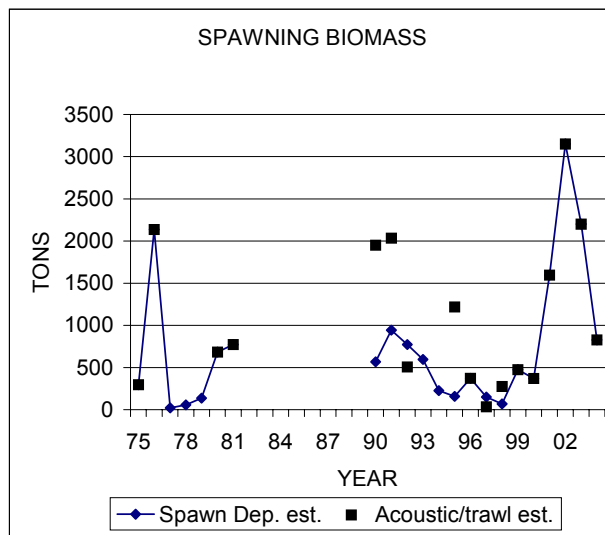


MEAN LENGTH OF 2/3/4/5 YEAR OLDS
139mm/152mm/161mm/168mm (2004)

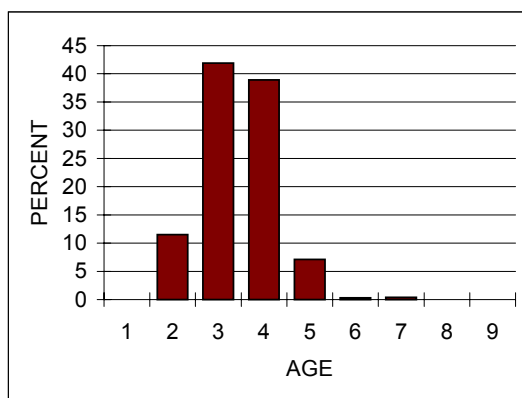
STOCK STATUS PROFILE for Squaxin Pass Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75		298	298	
76		2138	2138	
77	20		20	
78	58		58	
79	137		137	
80		683	683	
81		772	772	
82				
83				
84				
85				
86				
87				
88				
89				
90	566	1950	566	
91	943	2035	943	839
92	771	507	771	0
93	596		596	
94	225		225	
95	157	1219	157	
96		374	374	315
97	149	35	149	141
98	68	275	68	25
99		474	474	442
2000		371	371	360
2001		1597	1597	1120
2002		3150	3150	1301
2003		2201	2201	1159
2004		828	828	425
MEAN:				
25 year	434	1098	819	
5 year		1629	1629	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

fair/poor

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

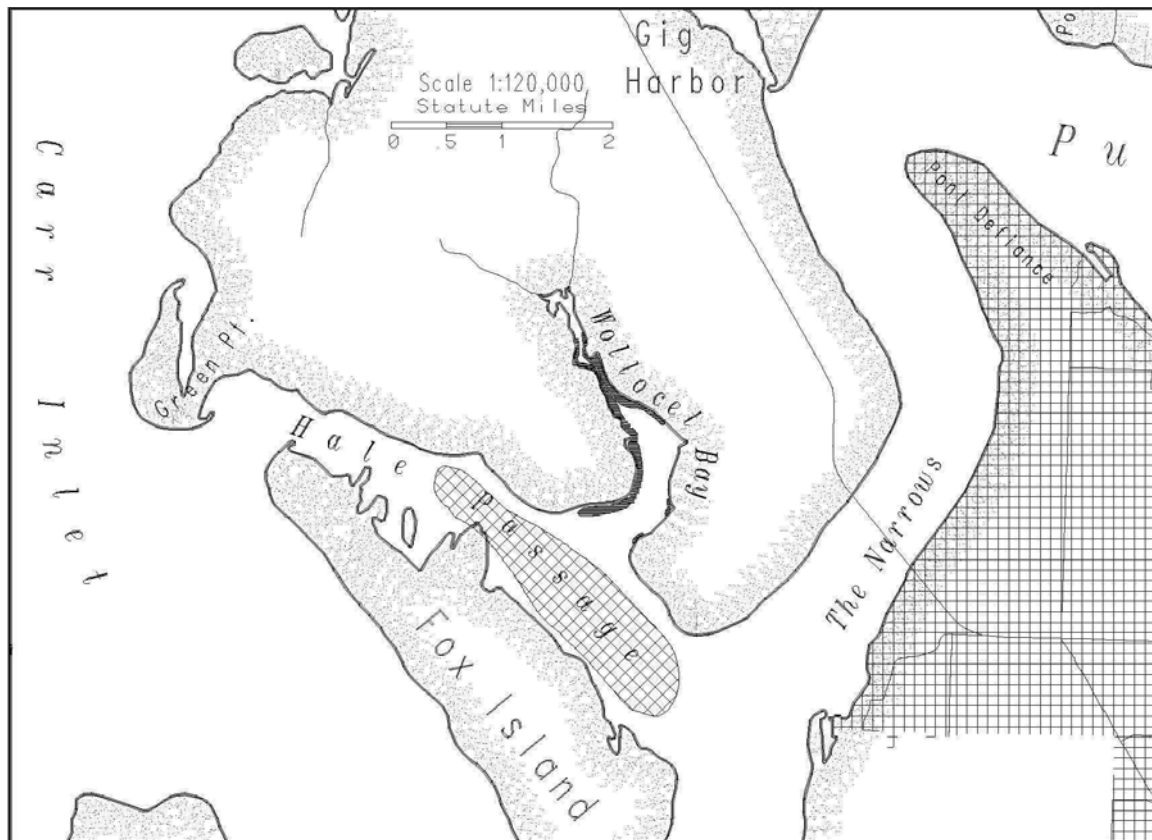
healthy: 185% of 25 yr mean spawning biomass

Wollochet Bay Herring Stock

OVERVIEW

The Wollochet Bay stock's spawning grounds were recently documented with spawn first observed during the 2000 season. This confirms reported spawning activity from the late 1930s (Chapman et al. 1941). Although stock size appears to be small, documented spawning grounds are likely to expand with continued annual spawn deposition survey effort. Pre-spawning fish attributed to this spawning ground congregate in Hale Passage.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

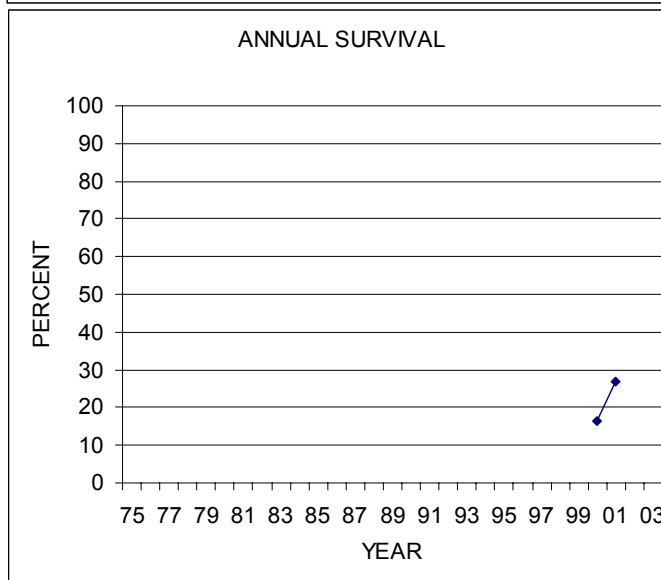
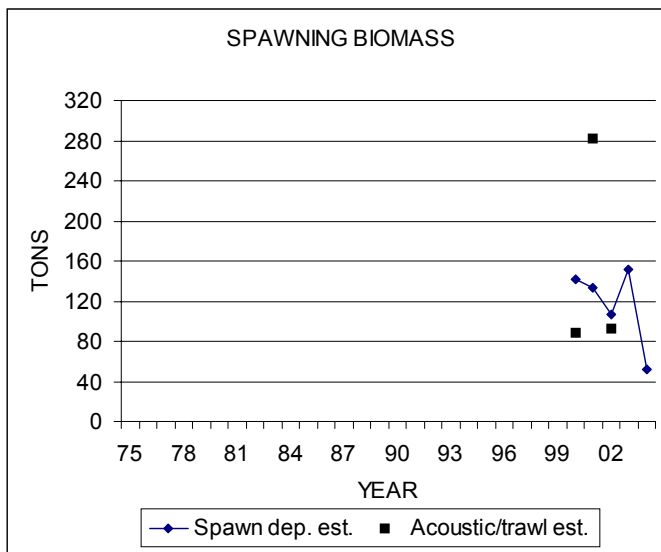
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
139mm/150mm/181mm/196mm (2002)

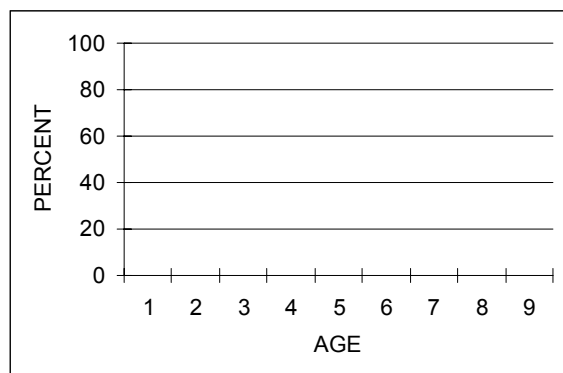
STOCK STATUS PROFILE for Wollochet Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
2000	142	89	142	
2001	133	282	133	101
2002	106	92	106	57
2003	152		152	
2004	52		52	
MEAN:				
25 year	117	154	117	
5 year	117	154	117	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY
no fishery

DATA QUALITY
poor

RECENT TREND (5 year)
stable

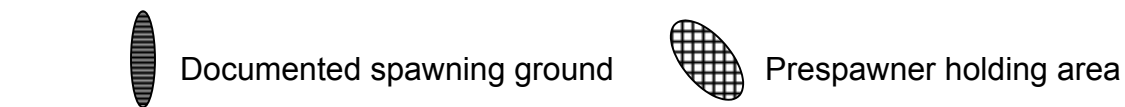
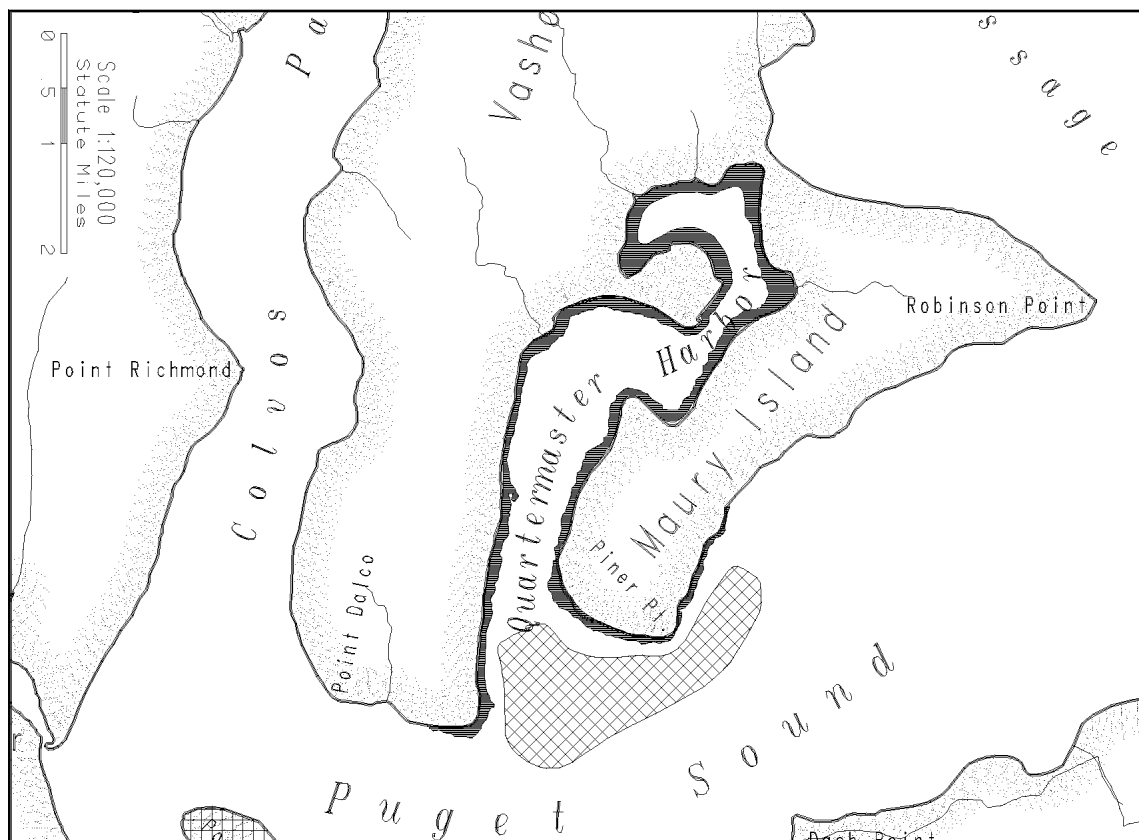
STOCK STATUS (2 year)
insufficient data

Quartermaster Harbor Herring Stock

OVERVIEW

The Quartermaster Harbor herring stock spawning activity occurs relatively early in the year, with spawning often beginning in early January. Spawn deposition is typically centered near Dockton on Maury Island. Growth and spawning behavior characteristics for this stock are considered to be average for central/south Puget Sound. Spawning biomass peaked in 1995, followed by a general decrease through 2004.

SPAWNING GROUND



SPAWNING TIMING

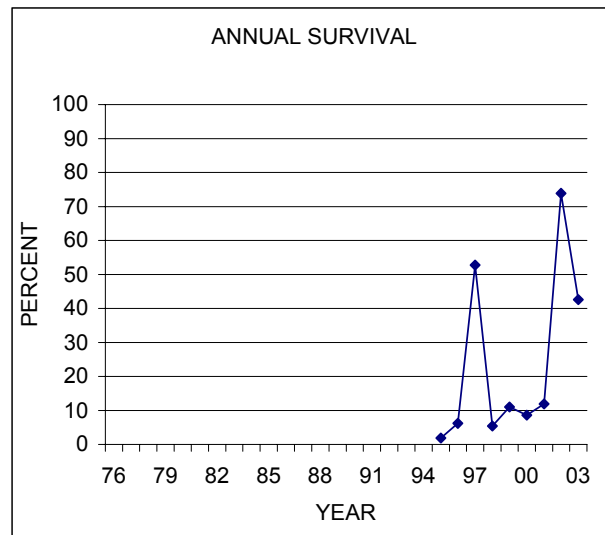
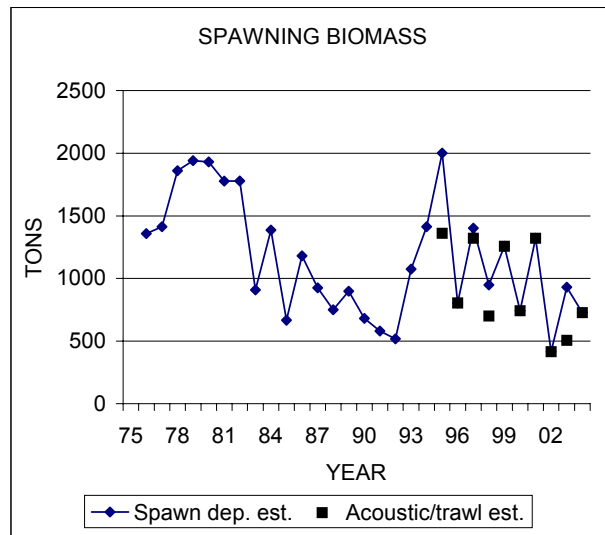


MEAN LENGTH OF 2/3/4/5 YEAR OLDS
141mm/154mm/170mm/179mm (2004)

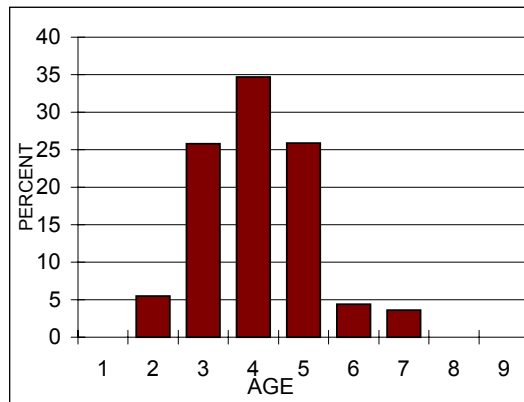
STOCK STATUS PROFILE for Quartermaster Harbor Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76	1357		1357	
77	1423		1413	
78	1860		1860	
79	1941		1941	
80	1930		1930	
81	1777		1777	
82	1778		1778	
83	909		909	
84	1386		1386	
85	667		667	
86	1181		1181	
87	924		924	
88	750		750	
89	898		898	
90	681		681	
91	580		580	
92	518		518	
93	1075		1075	
94	1412		1412	
95	2001	1362	2001	
96		805	805	757
97	1402	1321	1402	438
98	947	701	947	0
99		1257	1257	1200
2000		743	743	562
2001		1320	1320	1224
2002		416	416	213
2003	930	506	930	655
2004		727	727	136
MEAN:				
25 year	1145	916	1081	
5 year	930	742	827	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

good

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

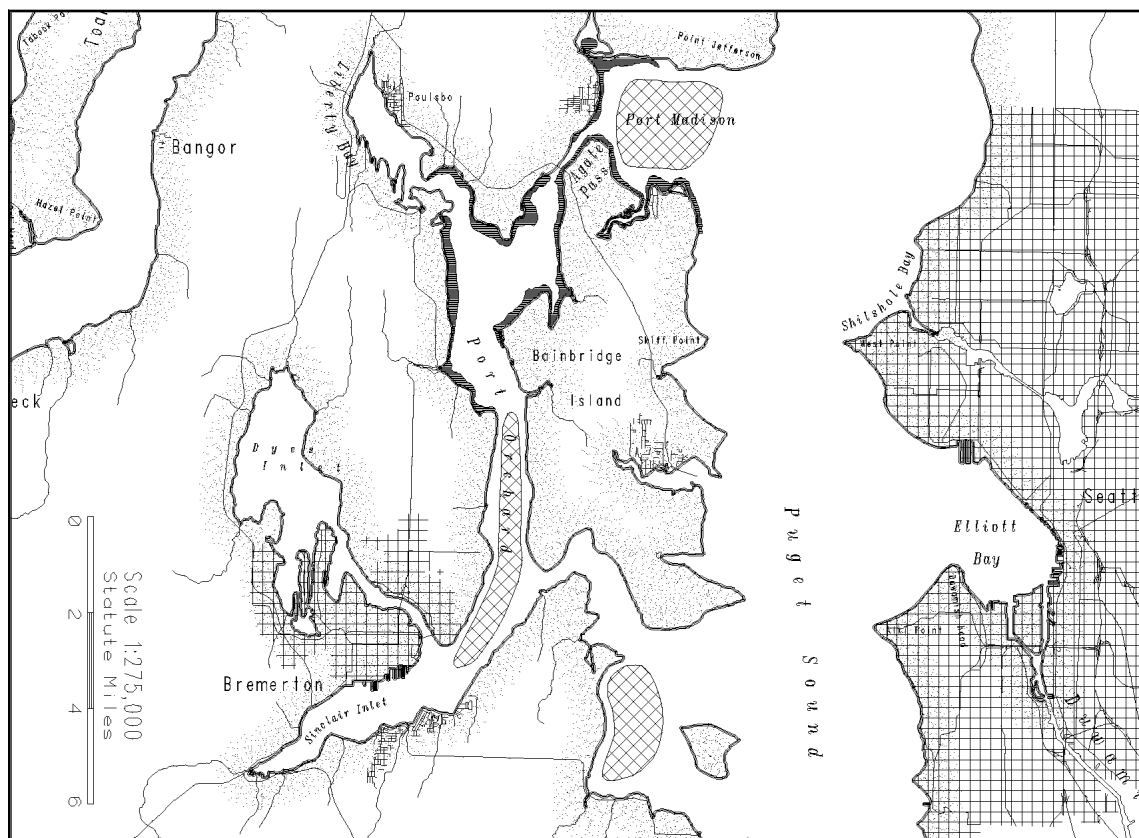
moderately healthy: 77% of 25 yr mean spawning biomass

Port Orchard/Madison Herring Stock

OVERVIEW

The Port Orchard/Madison herring stock abundance has increased since the low point in the 1990s. Spawn deposition in recent years has primarily been observed in Hidden Cove (north Bainbridge Island) and Point Bolin (southeast of Poulsbo) areas. Several separate pre-spawner holding areas are reliably observed. Significant *in situ* herring egg mortality is routinely seen in the Hidden Cove spawn.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
144mm/158mm/171mm/182mm (2004)

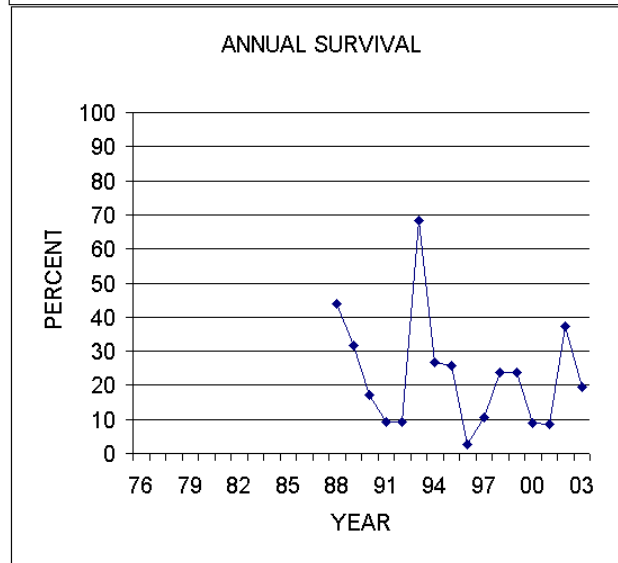
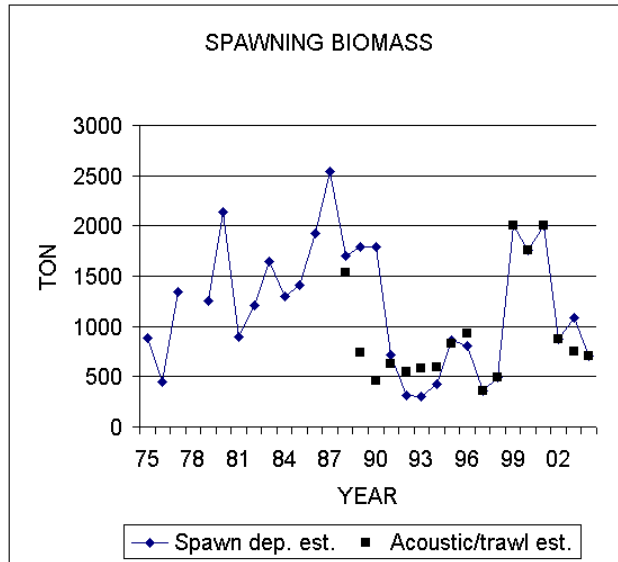
STOCK STATUS PROFILE for Port Orchard/Madison Herring Stock

STOCK ASSESSMENT

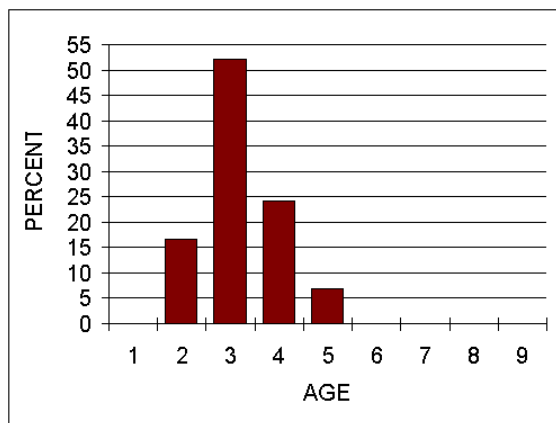
YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75	887		887	
76	447		447	
77	1348		1348	
78				
79	1255		1255	
80	2133		2133	
81	891		891	
82	1214		1214	
83	1651		1651	
84	1293		1293	
85	1415		1415	
86	1926		1926	
87	2538		2538	
88	1705	1537	1705	
89	1739	743	1795	853
90	1795	456	1795	1123
91	722	630	722	339
92	314	544	314	223
93	304	582	304	256
94	424	596	424	104
95	863	831	863	708
96	806	932	806	517
97		360	360	325
98		489	489	439
99		2006	2006	1809
2000		1756	1756	1139
2001		2007	2007	1770
2002		878	878	648
2003	1085	755	1085	673
2004		700	700	398

MEAN:

25 year	1268	930	1243
5 year	1085	1219	1285



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

good

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

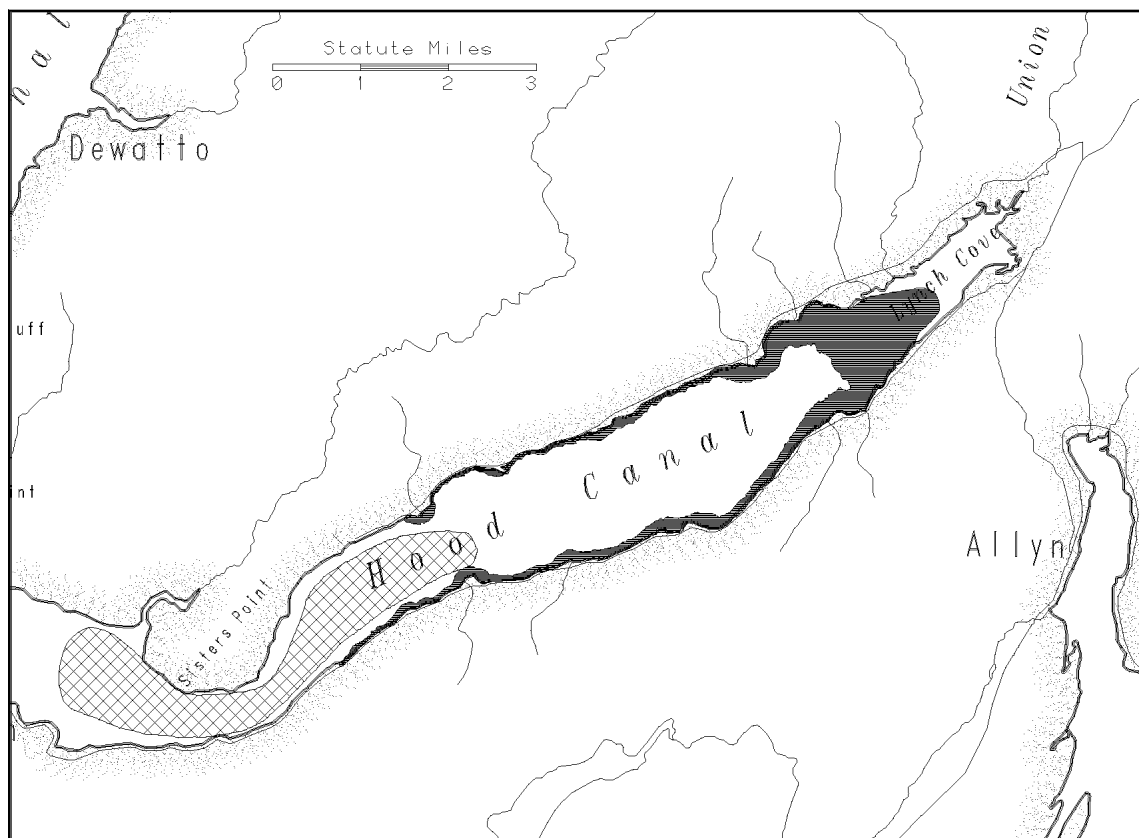
moderately healthy: 72% of 25 yr mean spawning biomass

South Hood Canal Herring Stock

OVERVIEW

Spawning activity by this small herring stock is generally confined to Lynch Cove at the head of south Hood Canal. Spawning starts relatively early (by mid-January) and typically is finished by early March. Estimated spawner biomass usually is about 200 tons, with a high of over 500 tons observed in 1999. Recent low dissolved oxygen levels in Hood Canal have apparently not yet caused significant decreases in estimated herring spawning biomass for this stock.

SPAWNING GROUND

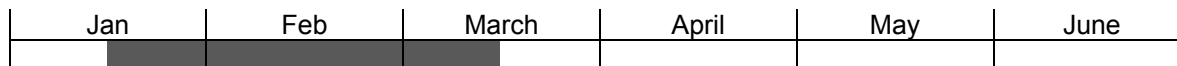


Documented spawning ground



Prespawner holding area

SPAWNING TIMING



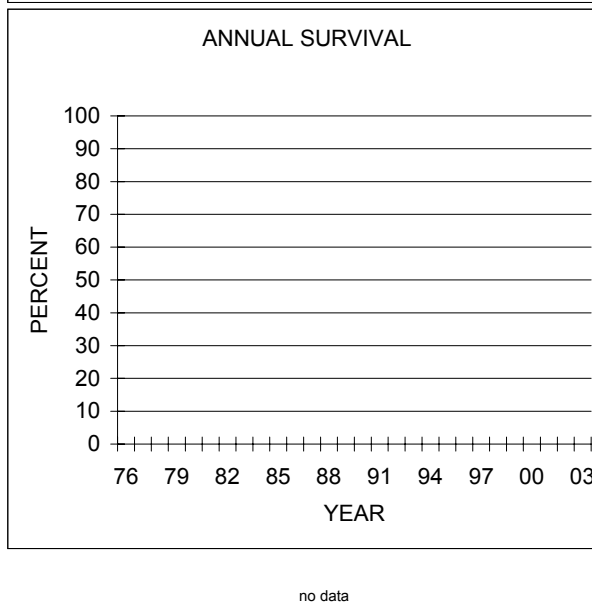
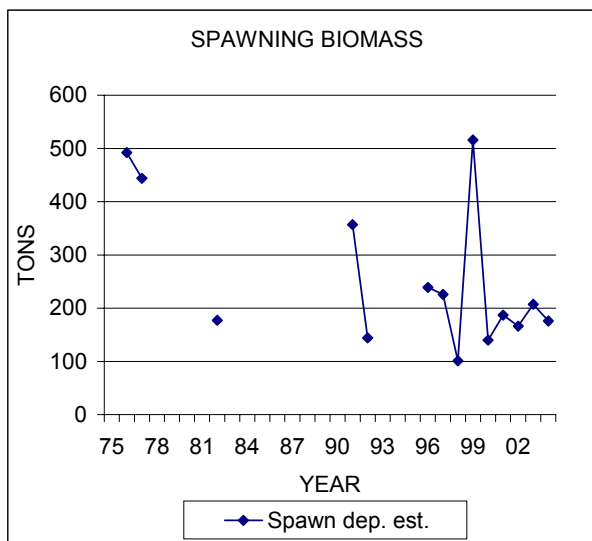
MEAN LENGTH OF 2/3/4/5 YEAR OLDS

No data

STOCK STATUS PROFILE for South Hood Canal Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76		492	492	
77		444	444	
78				
79				
80				
81				
82		177	177	
83				
84				
85				
86				
87				
88				
89				
90				
91		357	357	
92		144	144	
93				
94				
95				
96		239	239	
97		226	226	
98		101	101	
99		516	516	
2000		140	140	
2001		187	187	
2002		166	166	
2003		207	207	
2004		176	176	
MEAN:				
25 year		220	220	
5 year		175	175	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

poor

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

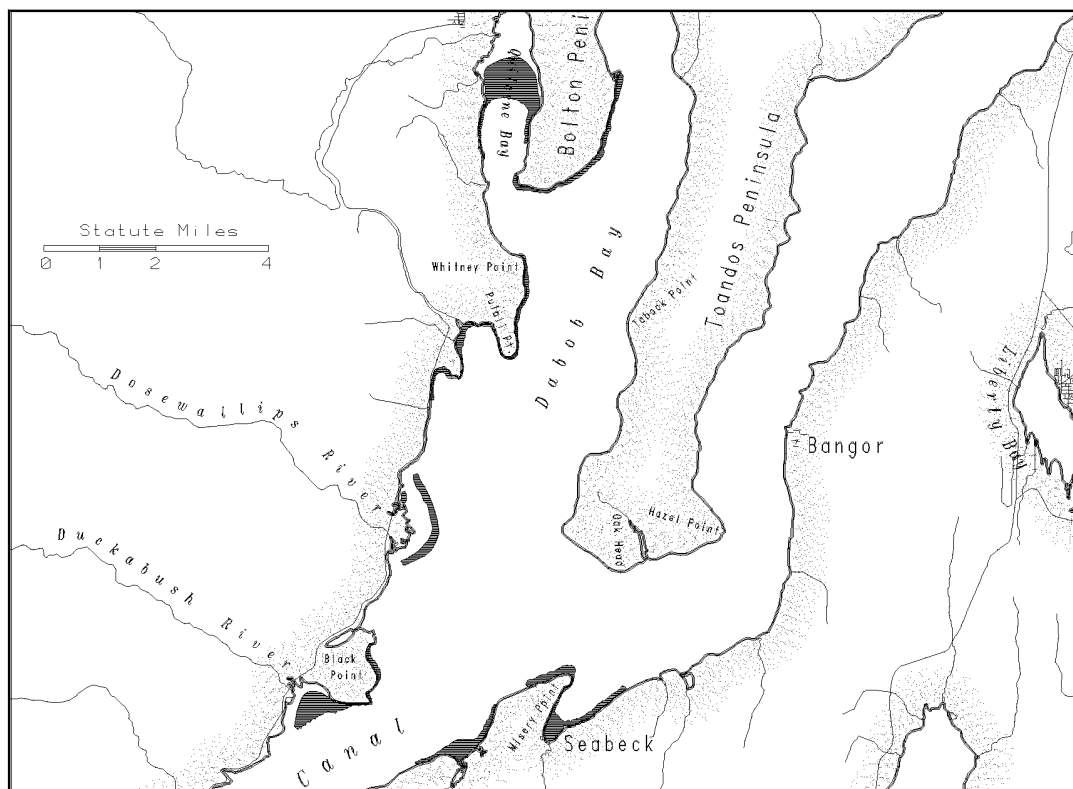
moderately healthy: 87% of 25 yr mean spawning biomass

Quilcene Bay Herring Stock

OVERVIEW

The Quilcene Bay herring stock is currently one of the largest in Puget Sound. Estimated spawning biomass has exceeded 2000 tons in five of the last six years. Documented spawning grounds have been significantly expanded since 1998. Much of the stock's spawn deposition in recent years has occurred at the south end of the Bolton Peninsula, along with significant deposition from Jackson Cove to Point Whitney. Several attempts to find and sample the expected large concentrations of pre-spawning herring in waters adjacent to spawning grounds have been unsuccessful. Observed inverse abundance relationship with Port Gamble stock may indicate spawning population linkage.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING



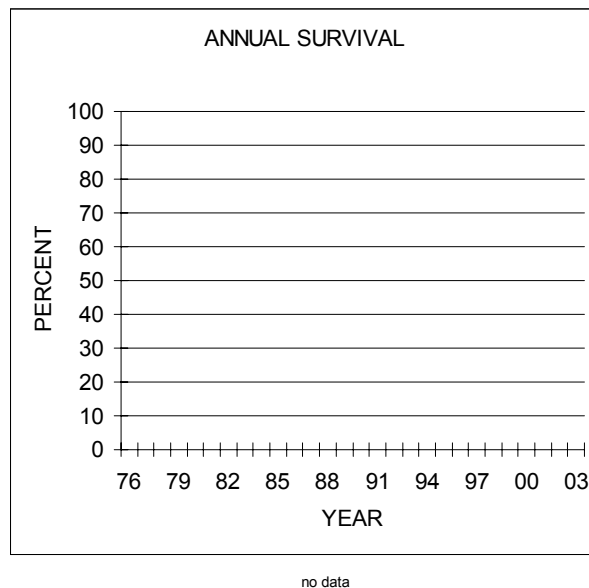
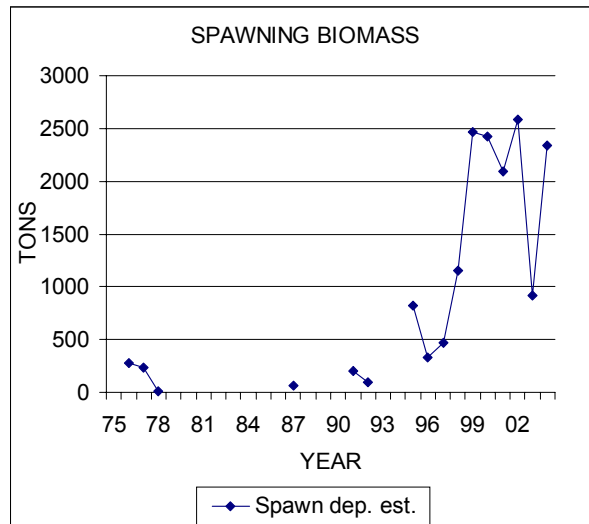
MEAN LENGTH OF 2/3/4/5 YEAR OLDS

No data

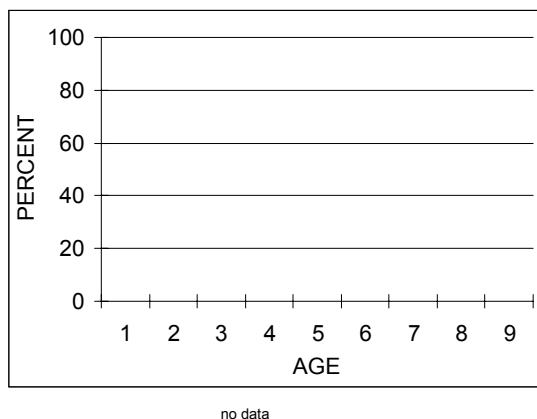
STOCK STATUS PROFILE for Quilcene Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76		279	279	
77		232	232	
78		14	14	
79				
80				
81				
82				
83				
84				
85				
86				
87		68	68	
88				
89				
90				
91		204	204	
92		97	97	
93				
94				
95		817	817	
96		328	328	
97		465	465	
98		1152	1152	
99		2464	2464	
2000		2426	2426	
2001		2091	2091	
2002		2585	2585	
2003		916	916	
2004		2342	2342	
MEAN:				
25 year		1227	1227	
5 year		2072	2072	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

fair/poor

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

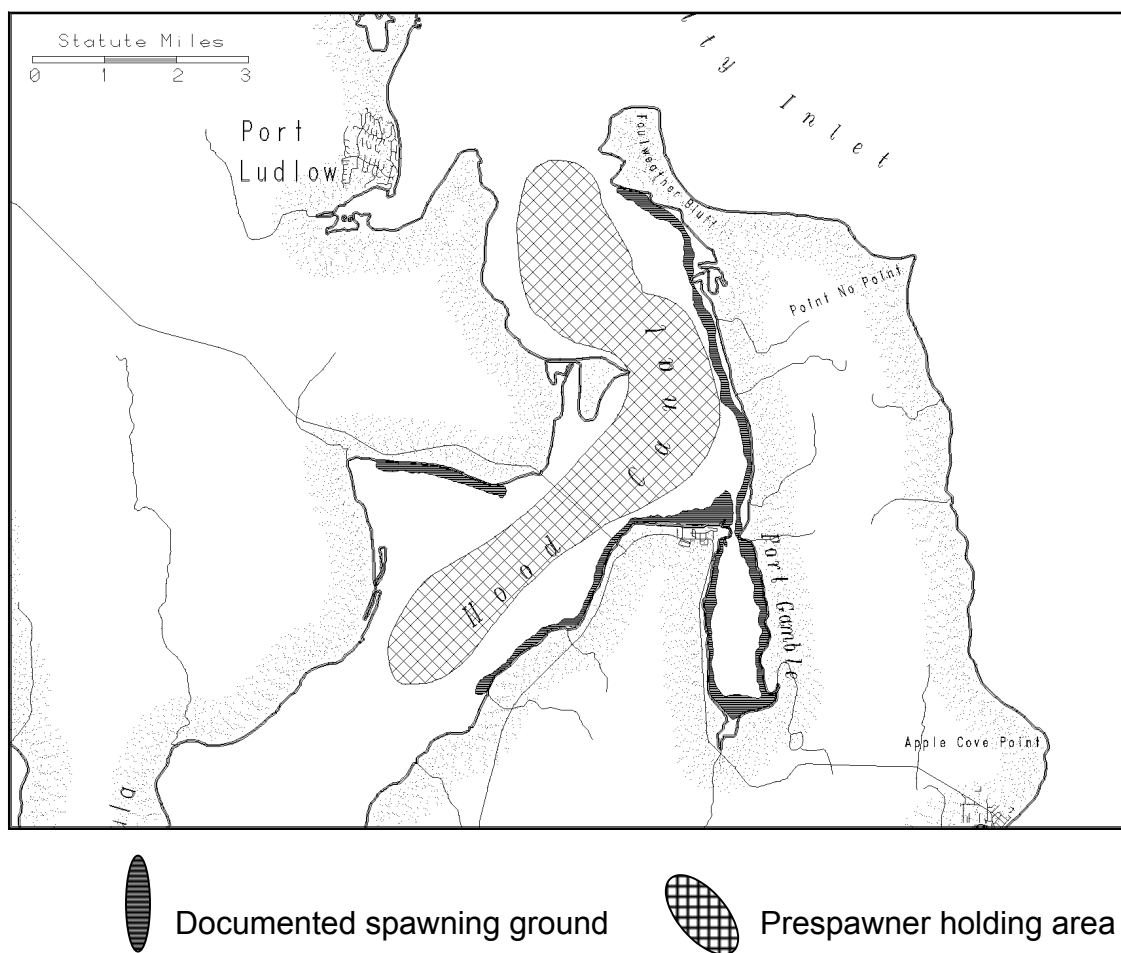
healthy: 133% of 25 yr mean spawning biomass

Port Gamble Herring Stock

OVERVIEW

The Port Gamble herring stock is one of the larger stocks in Puget Sound. Through 2004, the previous 25-year mean spawning biomass was over 2000 tons, although a low of less than 1000 tons was estimated for the 1998 season. Spawning activity is centered in Port Gamble Bay. Growth rates, spawning timing, and other stock characteristics are considered “typical” for a Puget Sound stock. Since 2003, previously reliable pre-spawner concentrations have inexplicably not been located by acoustic/trawl surveys; followed by normal distribution and timing of spawn deposition. Abundance trends compared to Quilcene Bay stock may indicate linkage between the two stocks.

SPAWNING GROUND



SPAWNING TIMING

Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
148mm/167mm/179mm/209mm (2002)

STOCK STATUS PROFILE for Port Gamble Herring Stock

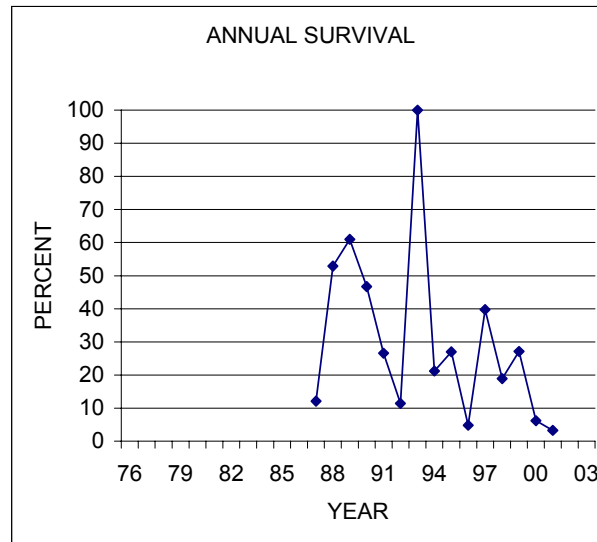
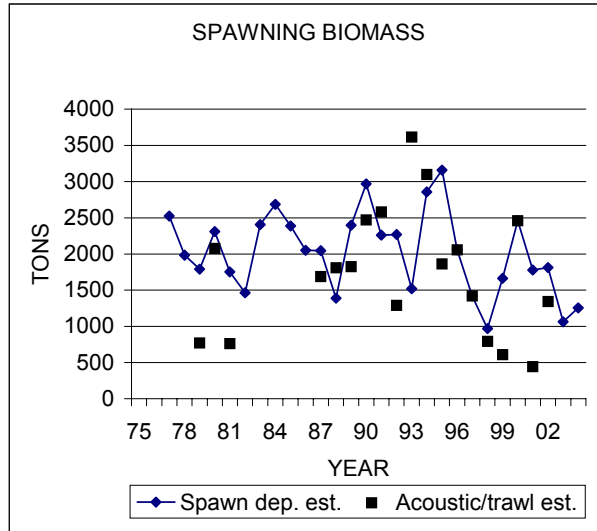
STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76				
77			2525	
78	1984		1984	
79	1790	772	1790	
80	2309	2077	2309	
81	1753	761	1753	
82	1463		1463	
83	2407		2407	
84	2685		2685	
85	2387		2387	
86	2050		2050	
87	2046	1688	2046	
88	1390	1808	1390	980
89	2395	1824	2395	1567
90	2969	2470	2969	811
91	2259	2579	2259	655
92	2270	1291	2270	1569
93	1521	3614	1521	1225
94	2857	3099	2857	327
95	3158	1862	3158	2402
96		2058	2058	947
97		1419	1419	1250
98	971	792	971	346
99	1664	608	1664	1429
2000		2459	2459	1916
2001	1779	444	1779.0	1526
2002	1812	1342	1812	1133
2003	1064		1064	
2004	1257		1257	

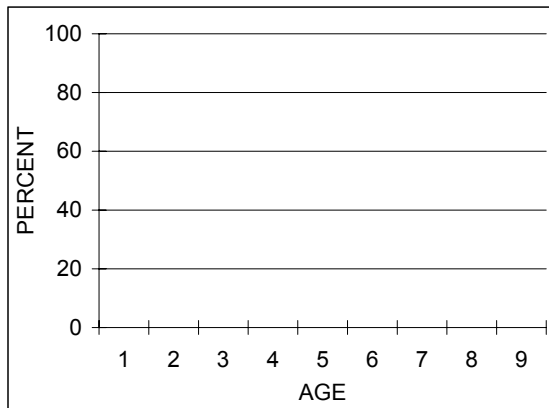
MEAN:

25 year 2021 1789 2016

5 year 1478 1415 1674



2004 BIOMASS AGE COMPOSITION



no data

STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

fair

RECENT TREND (5 year)

decreasing

STOCK STATUS (2 year)

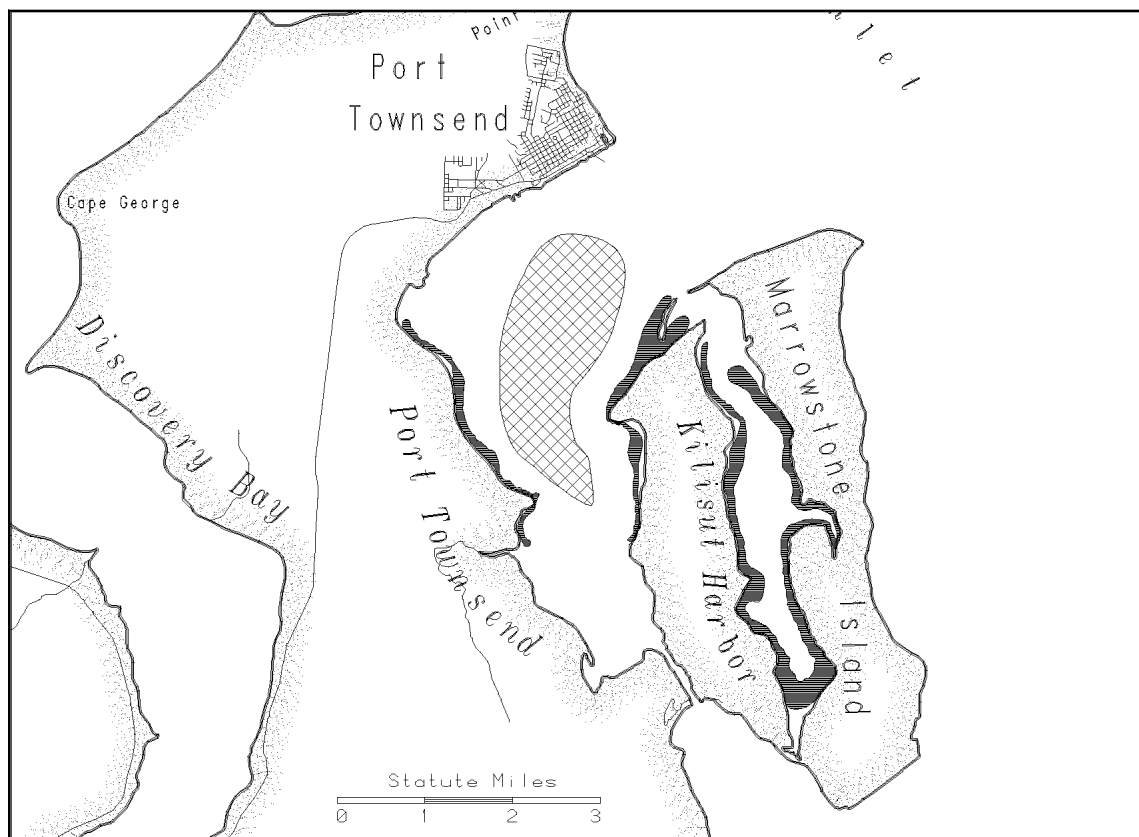
depressed: 58% of 25 yr mean spawning biomass

Kilisut Harbor Herring Stock

OVERVIEW

The Kilisut Harbor herring stock is a small south/central Puget Sound stock with recent years' observed spawning activity entirely within Kilisut Harbor. A sizable concentration of pre-spawning herring usually can be found in Port Townsend Bay prior to spawning. Spawning activity usually begins in early February with peak spawning in March. Growth characteristics are average for Puget Sound.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

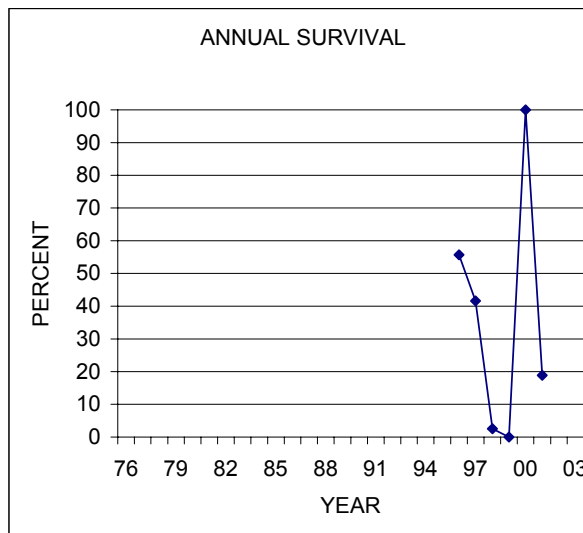
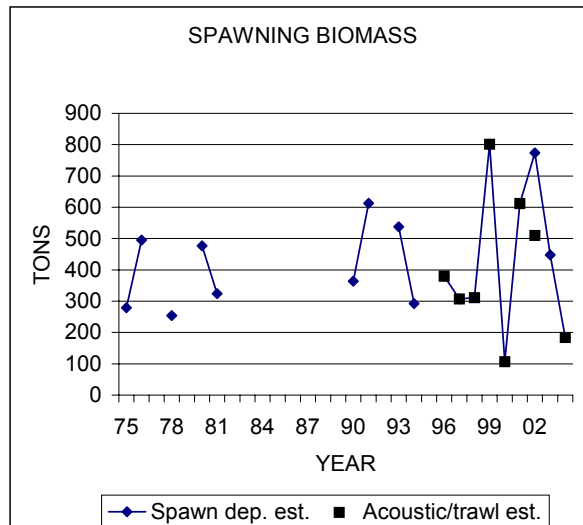
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
145mm/159mm/180mm/186mm (2004)

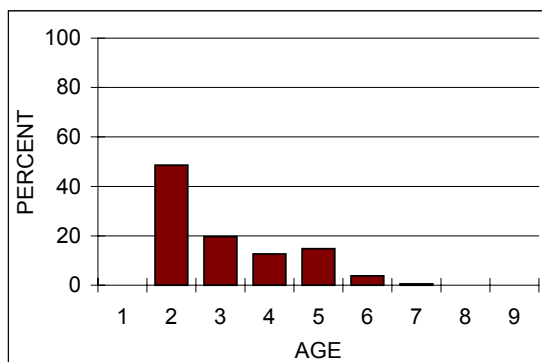
STOCK STATUS PROFILE for Kilisut Harbor Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75	279		279	
76	495		495	
77				
78	254		254	
79				
80	477		477	
81	324		324	
82				
83				
84				
85				
86				
87				
88				
89				
90	364		364	
91	613		613	
92				
93	538		538	
94	292		292	
95				
96		380	380	
97		307	307	0
98		311	311	170
99		802	802	792
2000		107	107	107
2001		612	612	393
2002	774	510	774	629
2003	448		448	
2004		184	184	
MEAN:				
25 year	479	402	436	
5 year	611	353	425	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY
no fishery

DATA QUALITY
fair/poor

RECENT TREND (5 year)
stable

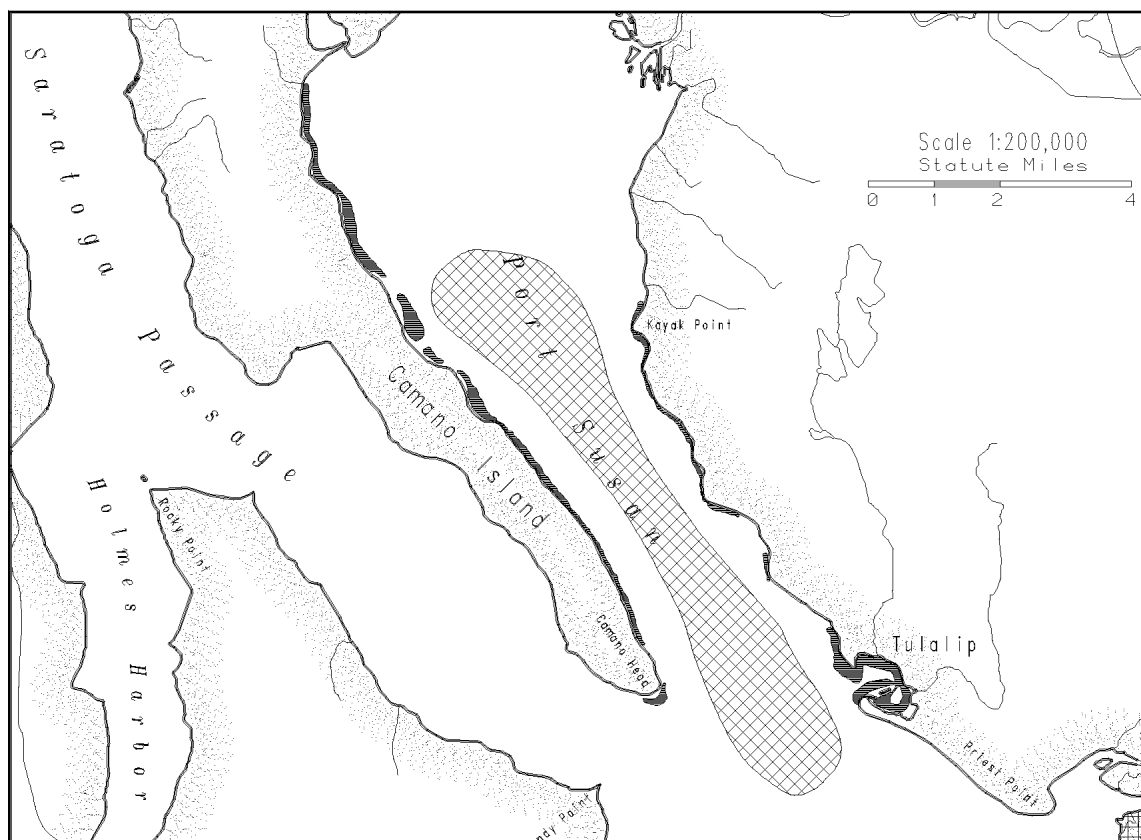
STOCK STATUS (2 year)
moderately healthy: 73% of 25 yr mean spawning biomass

Port Susan Herring Stock

OVERVIEW

The Port Susan herring stock often deposits significant spawn on rocks and gravel. Outside of Tulalip Bay, marine algae normally used by herring as spawning substrate are sparse in the Port Susan area. This behavior makes acoustic/trawl survey assessment the method of choice for this stock. Spawning biomass has hovered around 500 tons since a peak of over 2000 tons in 1998.

SPAWNING GROUND



SPAWNING TIMING

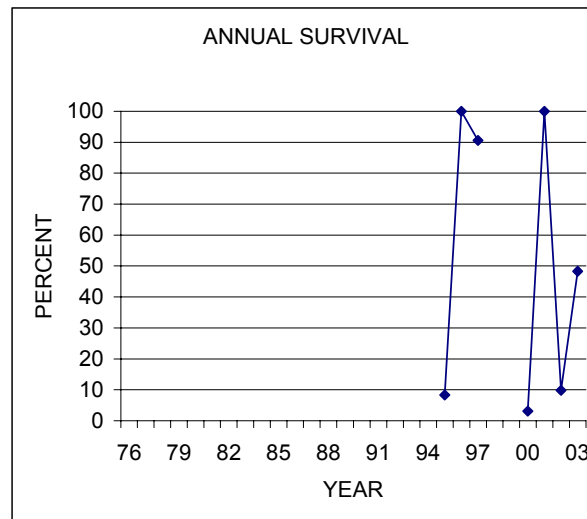
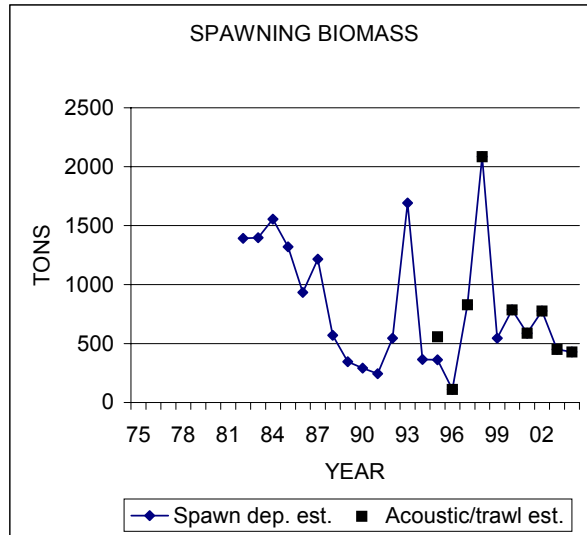
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
147mm/160mm/171mm/177mm (2004)

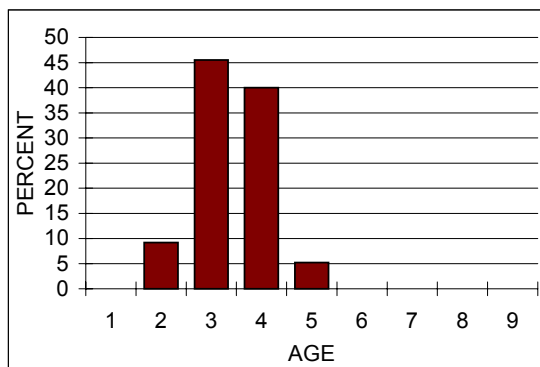
STOCK STATUS PROFILE for Port Susan Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76				
77				
78				
79				
80				
81				
82	1391		1391	
83	1398		1398	
84	1555		1555	
85	1321		1321	
86	934		934	
87	1216		1216	
88	570		570	
89	345		345	
90	291		291	
91	245		245	
92	545		545	
93	1693		1693	
94	365		365	
95	363	557	363	
96		110	110	75
97		828	828	670
98		2084	2084	1276
99	545		545	
2000		785	785	
2001		587	587	557
2002		775	775	72
2003		450	450	374
2004		429	429	154
MEAN:				
25 year	852	734	818	
5 year	545	1058	955	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

fair

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

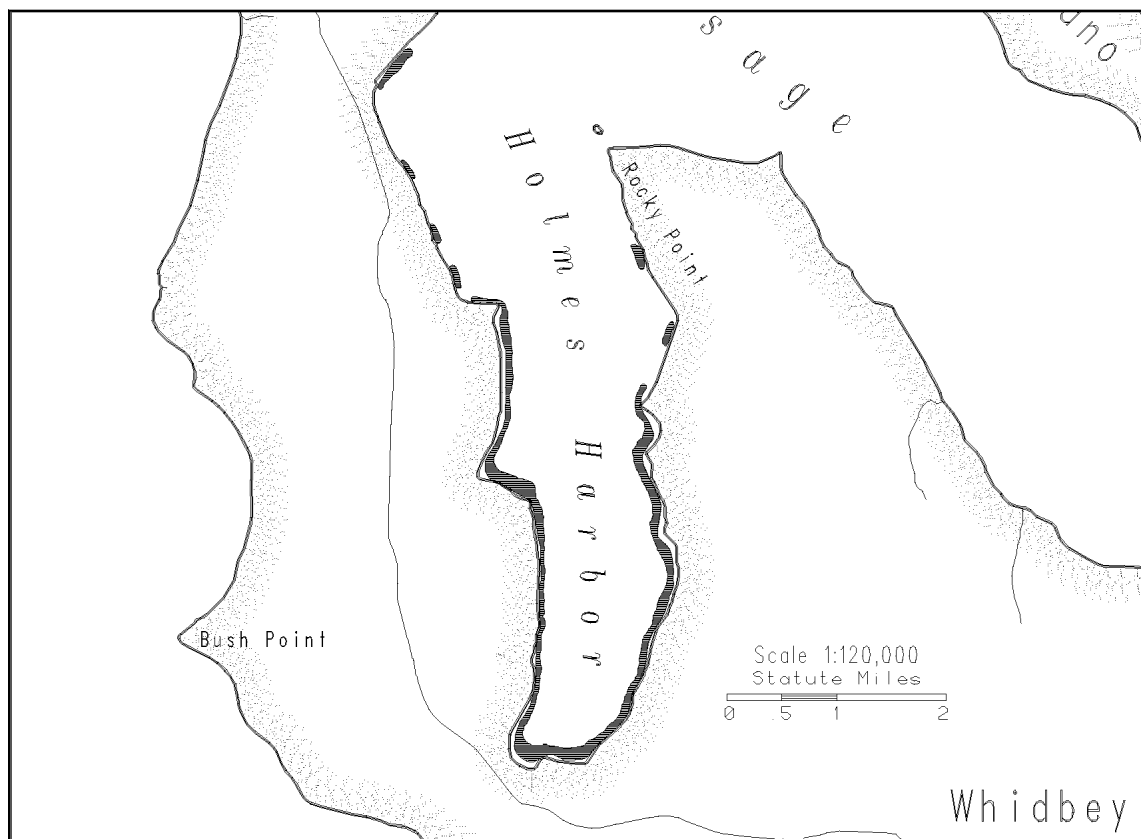
depressed: 54% of 25 yr mean spawning biomass

Holmes Harbor Herring Stock

OVERVIEW

Recent spawning activity by the Holmes Harbor stock has expanded to include more shoreline than routinely observed in prior years. Current spawning biomass is relatively high. Spawning timing is later than most Puget Sound stocks, with most activity from mid-March to early April.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

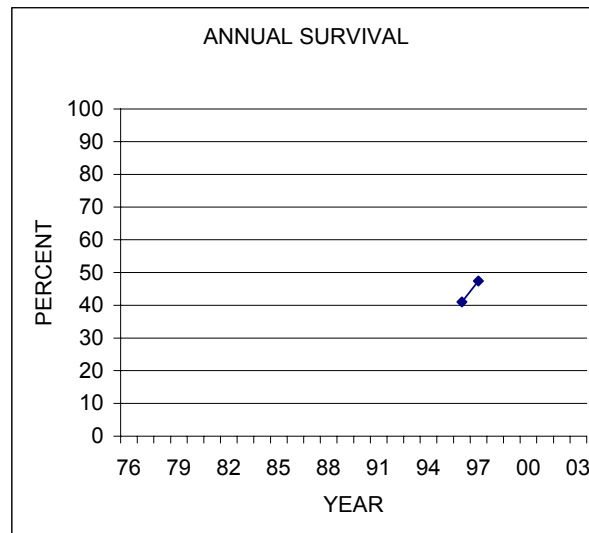
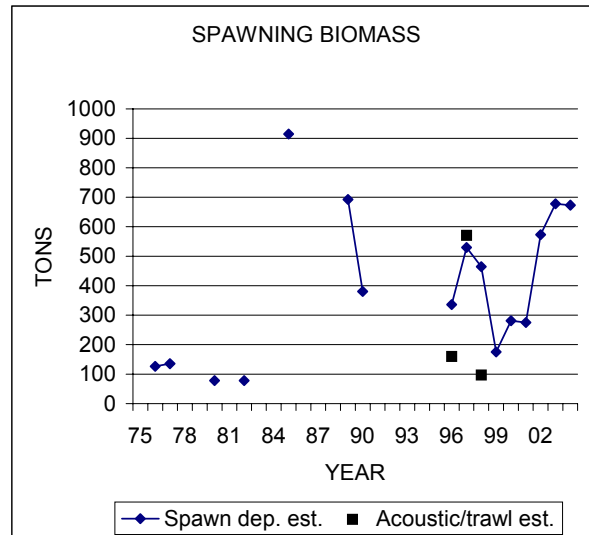
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
146mm/162mm/197mm/215mm (1998)

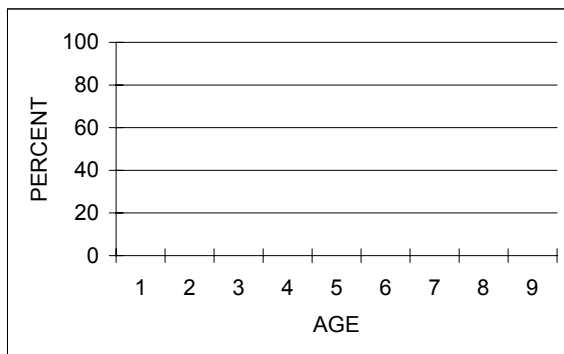
STOCK STATUS PROFILE for Holmes Harbor Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76	126		126	
77	135		135	
78				
79				
80	78		78	
81				
82	78		78	
83				
84				
85	914		914	
86				
87				
88				
89	693		693	
90	380		380	
91				
92				
93				
94				
95				
96	336	160	336	
97	530	571	530	328
98	464	97	464	141
99	175		175	
2000	281		281	
2001	275		275	
2002	573		573	
2003	678		678	
2004	673		673	
MEAN:				
25 year	438	276	438	
5 year	496		496	



2004 BIOMASS AGE COMPOSITION



no data

STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

poor

RECENT TREND (5 year)

increasing

STOCK STATUS (2 year)

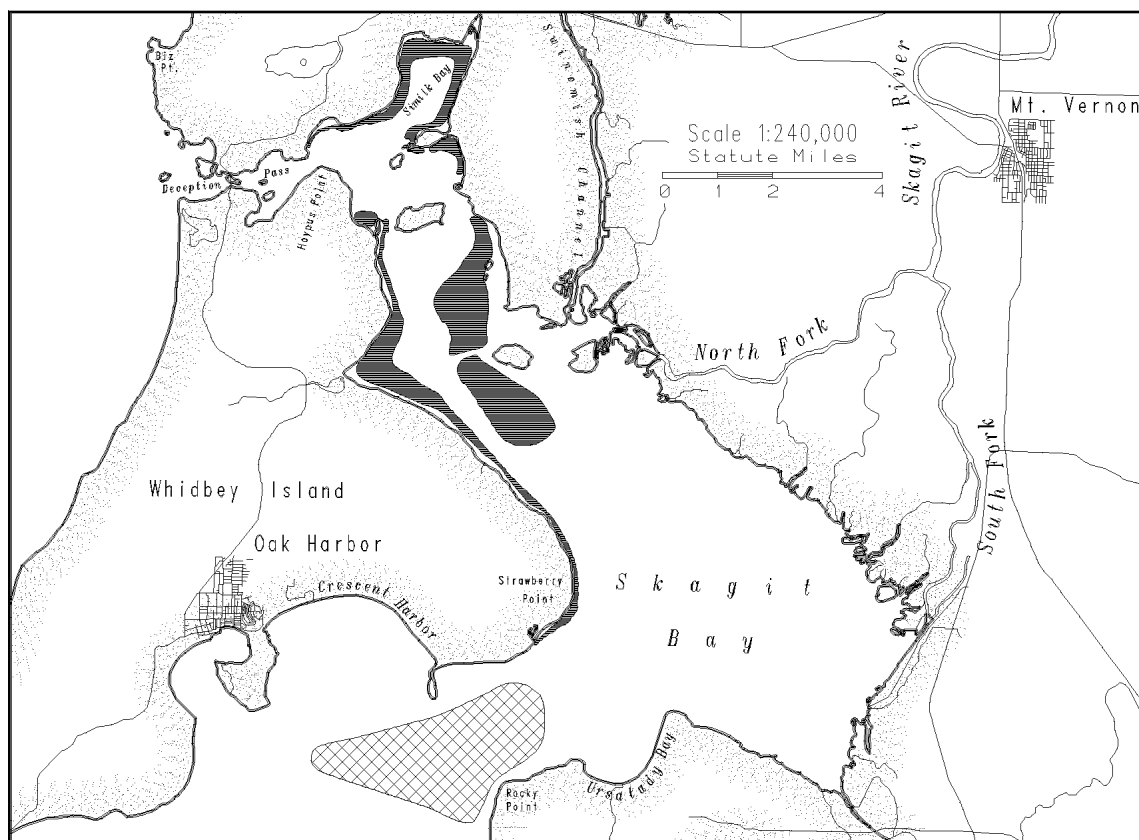
healthy: 154% of 25 yr mean spawning biomass

Skagit Bay Herring Stock

OVERVIEW

The Skagit Bay herring stock is currently one of the larger stocks in Puget Sound. Acoustic/trawl surveys have observed large pre-spawner and juvenile herring concentrations in the north end of Saratoga Passage. Observed spawn deposition in recent years has primarily been in Similk Bay.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

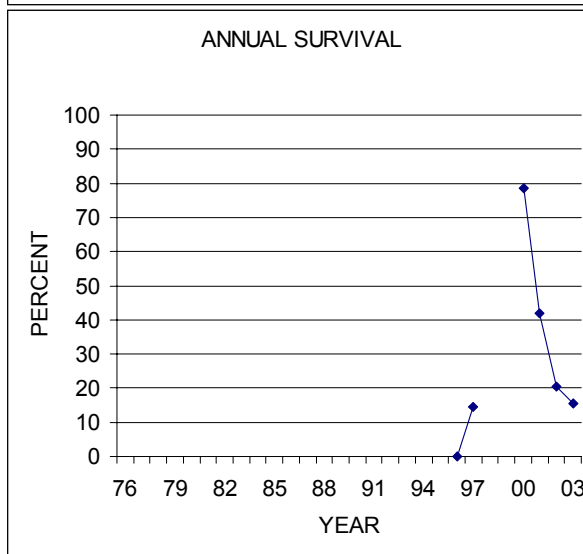
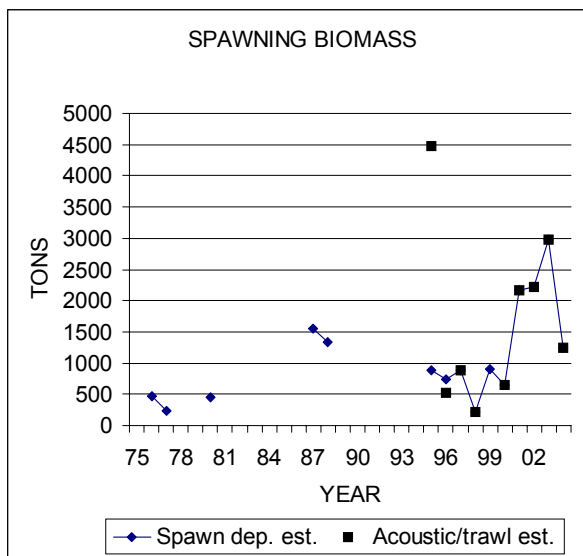
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
143mm/154mm/163mm/169mm (2004)

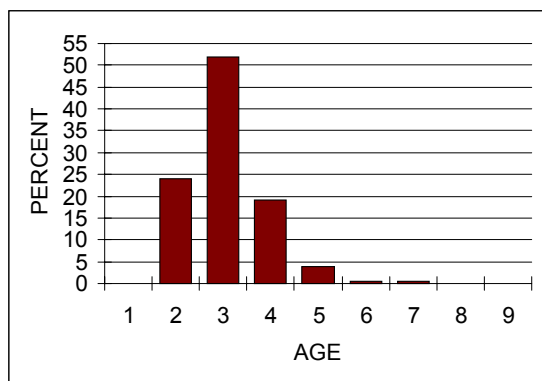
STOCK STATUS PROFILE for Skagit Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76			478	
77			227	
78				
79				
80	453		453	
81				
82				
83				
84				
85				
86				
87	1552		1552	
88	1340		1340	
89				
90				
91				
92				
93				
94				
95	891	4480	891	
96	736	521	736	736
97		893	893	892
98		209	209	31
99	905		905	
2000		646	646	
2001		2170	2170	1309
2002		2215	2215	1212
2003		2983	2983	2517
2004		1245	1245	692
MEAN:				
25 year	980	1707	1249	
5 year		1852	1852	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

poor

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

healthy: 169% of 25 yr mean spawning biomass

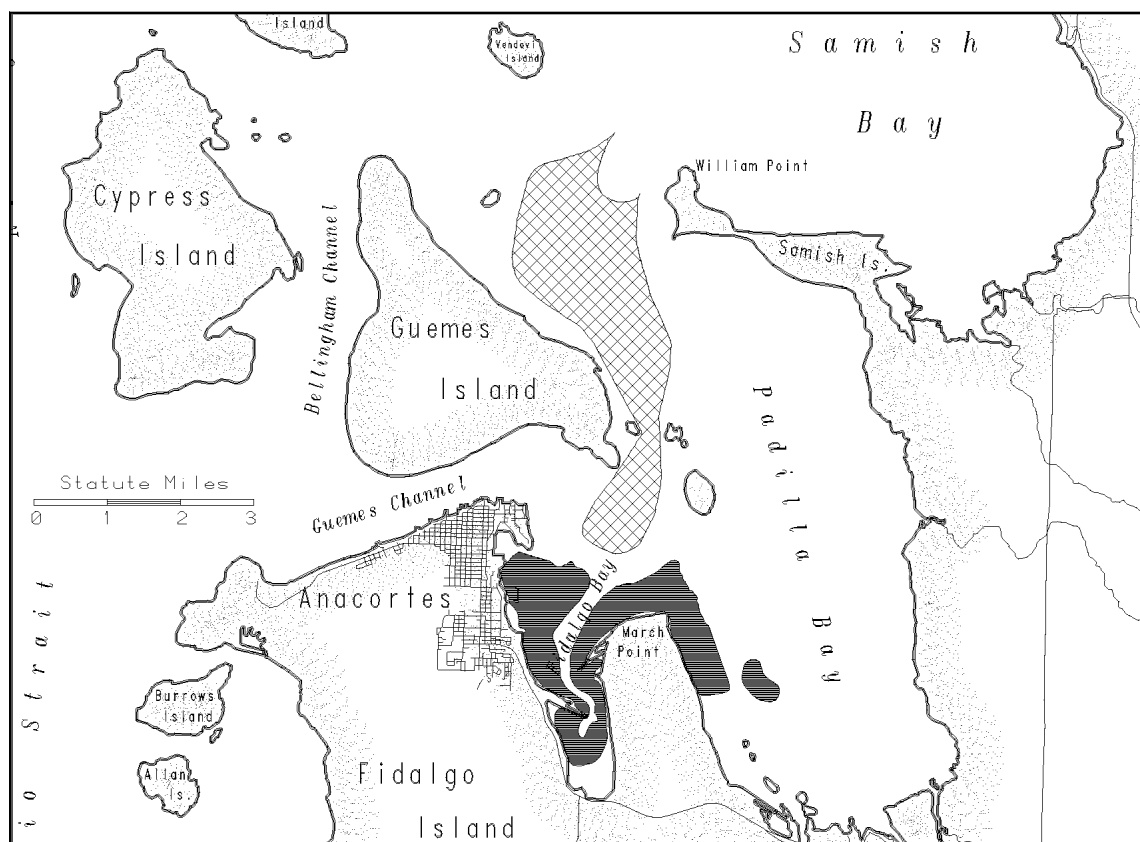
North Puget Sound Herring Stock Profiles

Fidalgo Bay Herring Stock

OVERVIEW

A medium-sized north Puget Sound herring stock, the proximity of the Fidalgo Bay stock's spawning grounds to oil refinery activities at March Point make its status of particular interest. Spawn deposition takes place at very low densities over the large shallow eelgrass flats that encompass most of the bay. Estimated spawning biomass in the last two years has been low.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

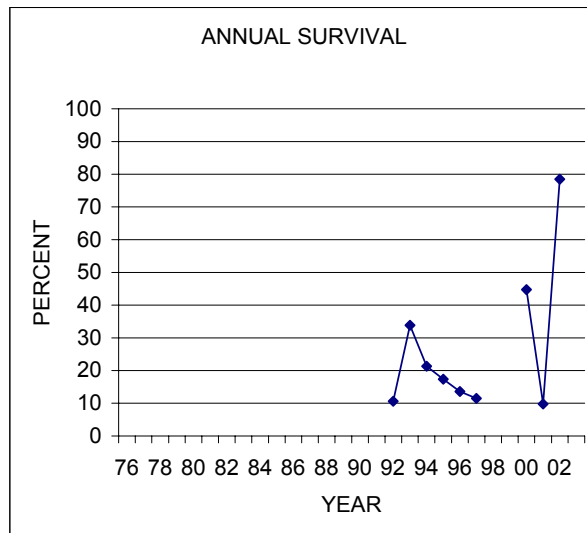
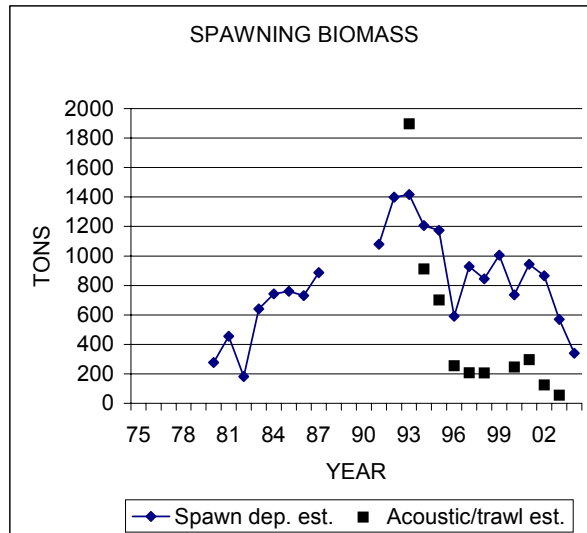
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
148mm/157mm/177mm/204mm (2003)

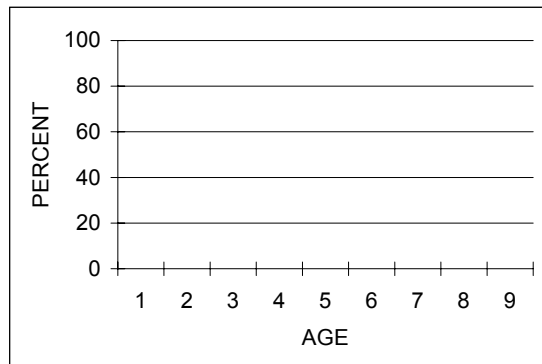
STOCK STATUS PROFILE for Fidalgo Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76				
77				
78				
79				
80	276		276	
81	456		456	
82	182		182	
83	640		640	
84	742		742	
85	761		761	
86	731		731	
87	887		887	
88				
89				
90				
91	1079		1079	
92	1399		1399	
93	1417	1896	1417	1206
94	1207	912	1207	590
95	1173	702	1173	882
96	590	255	590	273
97	929	208	929	800
98	844	206	844	680
99	1005		1005	
2000	737	246	737	
2001	944	296	944	500
2002	865	124	865	737
2003	569	55	569	49
2004	339		339	
MEAN:				
25 year	808	490	808	
5 year	691	180	691	



2004 BIOMASS AGE COMPOSITION



no data

STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

fair

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

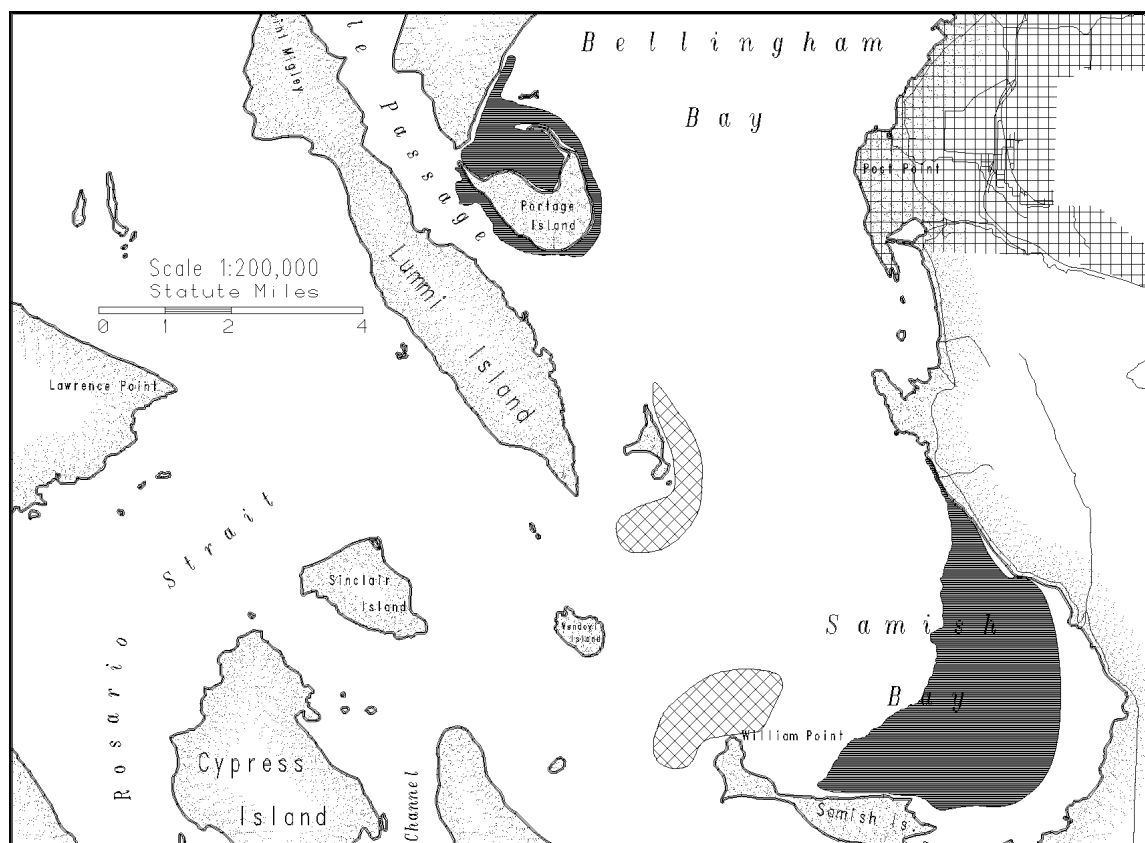
depressed: 56% of previous 25 yr mean spawning biomass

Samish/Portage Bay Herring Stock

OVERVIEW

Spawning by this small north Puget Sound stock occurs in both Samish Bay and Portage Bay. The majority of spawning activity in recent years has been observed in Portage Bay. Spawning activity typically occurs from early February to late March.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

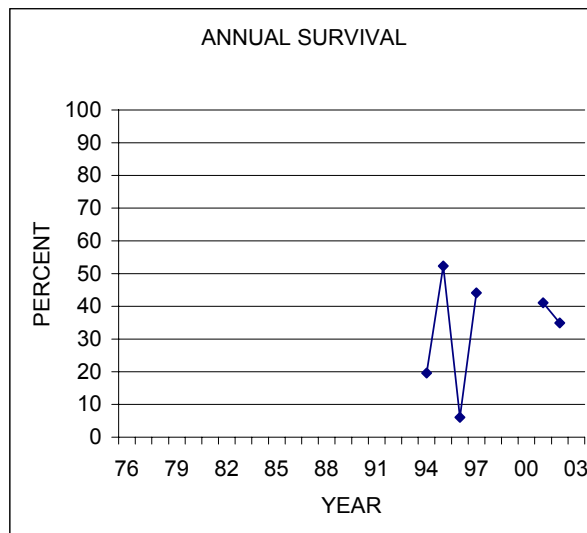
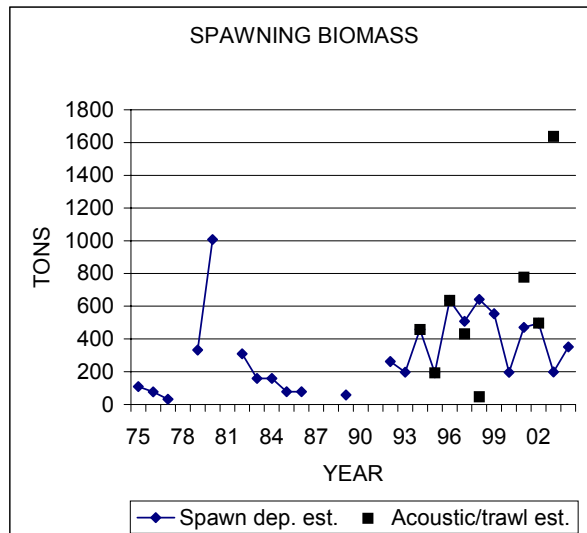
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
146mm/166mm/185mm/192mm (2003)

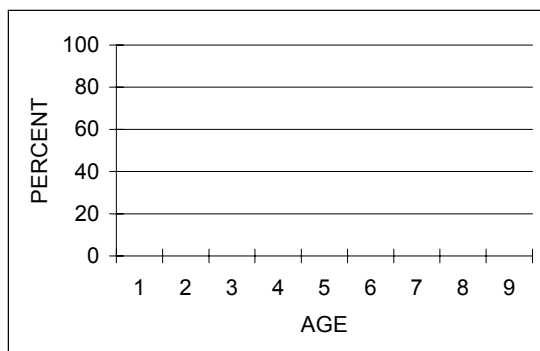
STOCK STATUS PROFILE for Samish/Portage Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75	109		109	
76	77		77	
77	32		32	
78				
79	333		333	
80	1008		1008	
81				
82	310		310	
83	159		159	
84	160		160	
85	78		78	
86	79		79	
87				
88				
89	58		58	
90				
91				
92	262		262	
93	198		198	
94		459	459	
95		194	194	66
96		636	636	487
97	509	431	509	452
98	643	48	643	419
99	555		555	
2000	196		196	
2001	470	778	470	
2002	496	497	496	283
2003	299	1638	199	20
2004	351		351	
MEAN:				
25 year	343	585	351	
5 year	362	971	342	



2004 BIOMASS AGE COMPOSITION



no data

STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

poor

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

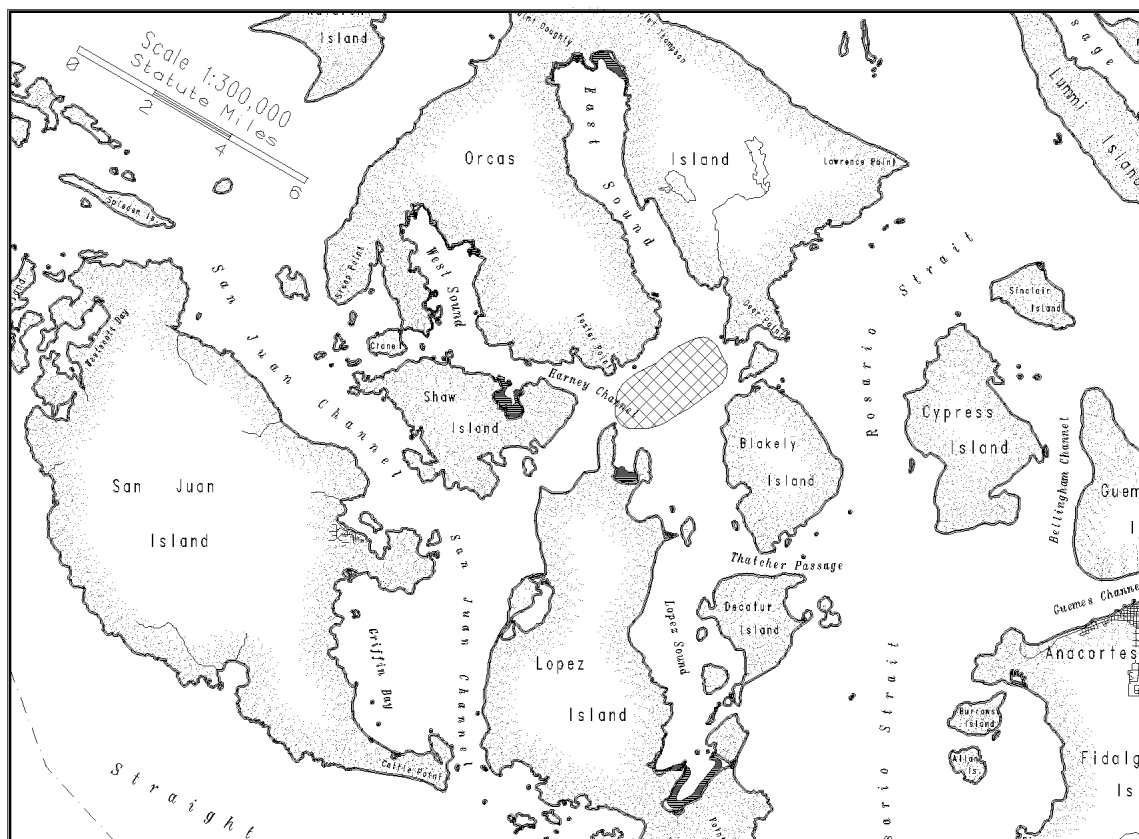
moderately healthy: 78% of 25 yr mean spawning biomass

Interior San Juan Islands Herring Stock

OVERVIEW

The Interior San Juan Islands herring stock is small with spawning grounds in several separate areas and one known pre-spawner holding area. Currently, the Mud-Hunter Bay, Lopez Island portion of documented spawning grounds receives the majority of spawn deposition. Spawning activity has been documented into late April. Sampling effort has been sporadic for this stock's spawning grounds.

SPAWNING GROUND



SPAWNING TIMING

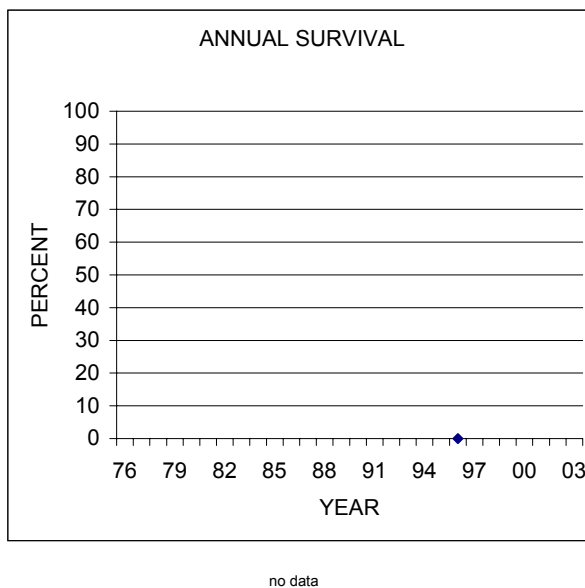
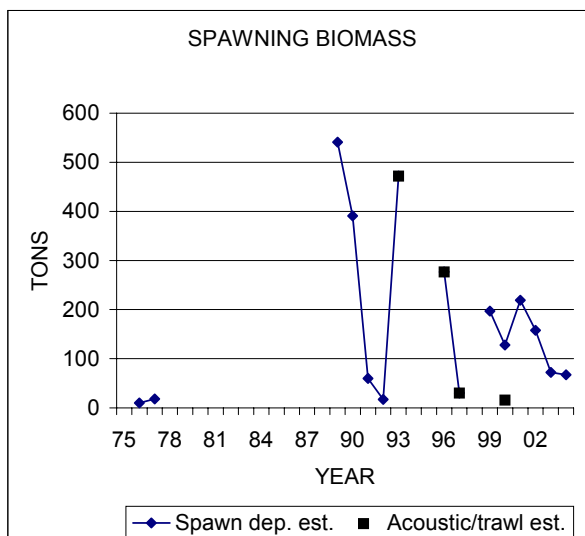
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
140mm/154mm/na/na (2000)

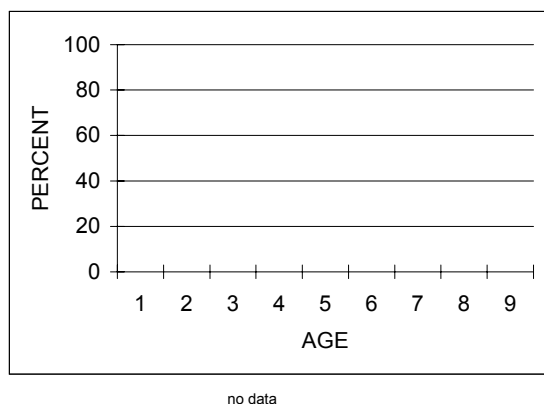
STOCK STATUS PROFILE for Interior San Juan Islands Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76		10	10	
77		18	18	
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89	541		541	
90	391		391	
91	60		60	
92	17		17	
93		472	472	
94				
95				
96		277	277	
97		30	30	30
98				
99	197		197	
2000	128	16	128	
2001	218		219	
2002	158		158	
2003	72		72	
2004	67		67	
MEAN:				
25 year	185	199	202	
5 year	129	16	176	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

poor

RECENT TREND (5 year)

insufficient data

STOCK STATUS (2 year)

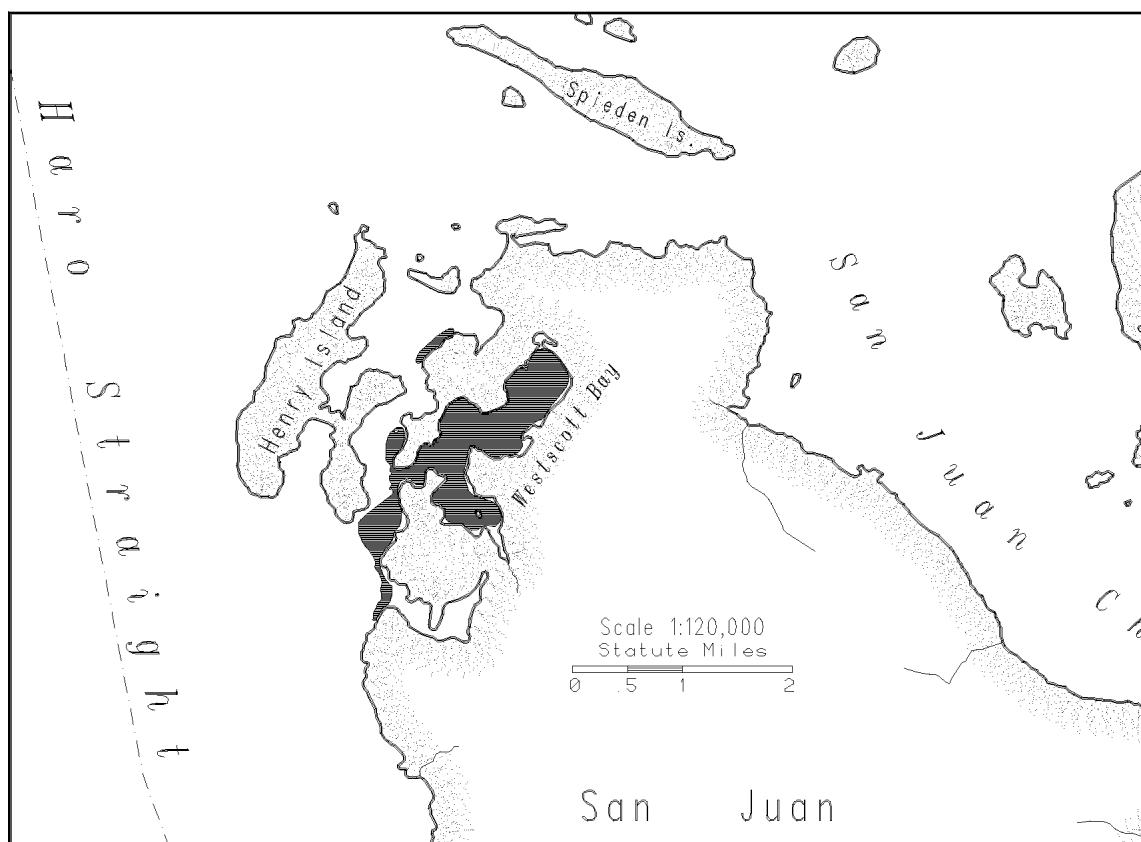
depressed: 34% of 25 yr mean spawning biomass

Northwest San Juan Island Herring Stock

OVERVIEW

The Northwest San Juan Island stock is a small stock with spawning grounds primarily in Westcott Bay and Garrison Bay on San Juan Island. Stock distinction from Interior San Juan Islands stock is based only on geographical separation. A dramatic decrease in eelgrass beds from unknown causes has been observed in these bays beginning in 2001. A shift in spawning location to other eelgrass beds in the vicinity (outside of Westcott and Garrison Bays) has not been documented. No spawn deposition was found in 2004.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

Jan	Feb	March	April	May	June

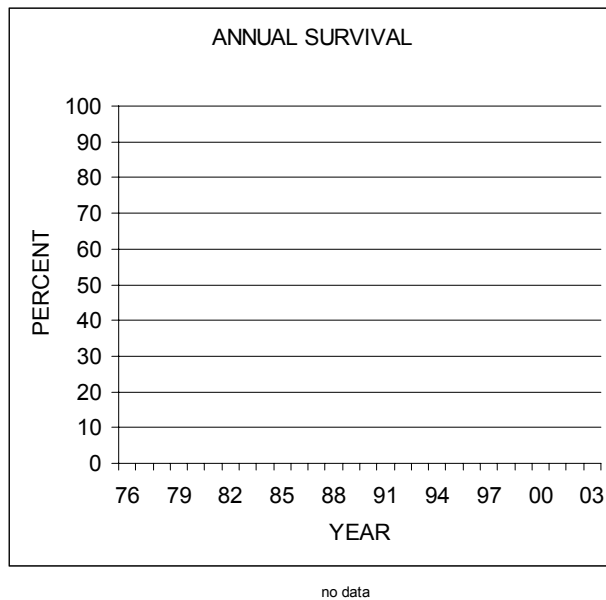
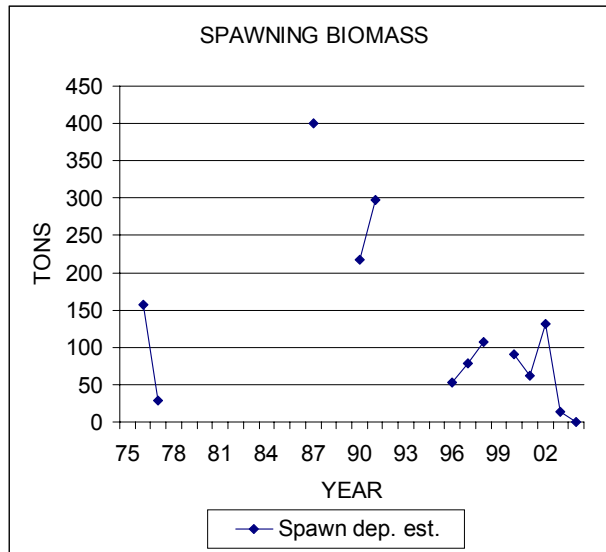
MEAN LENGTH OF 2/3/4/5 YEAR OLDS

No data

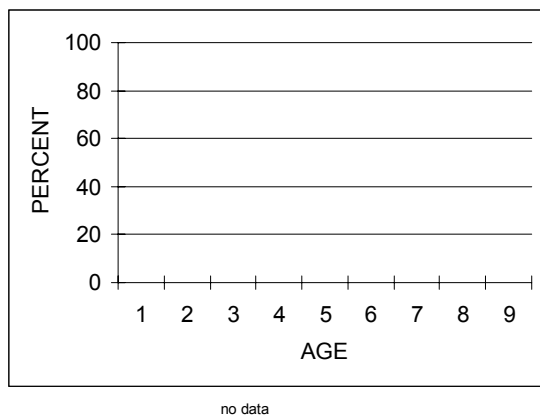
STOCK STATUS PROFILE for NW San Juan Island Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76	157		157	
77	29		29	
78				
79				
80				
81				
82				
83				
84				
85				
86				
87	400		400	
88				
89				
90	218		218	
91	298		298	
92				
93				
94				
95				
96	53		53	
97	79		79	
98	107		107	
99				
2000	90		90	
2001	62		62	
2002	131		131	
2003	13		13	
2004	0		0	
MEAN:				
25 year	132		132	
5 year	59		59	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

poor

RECENT TREND (5 year)

insufficient data

STOCK STATUS (2 year)

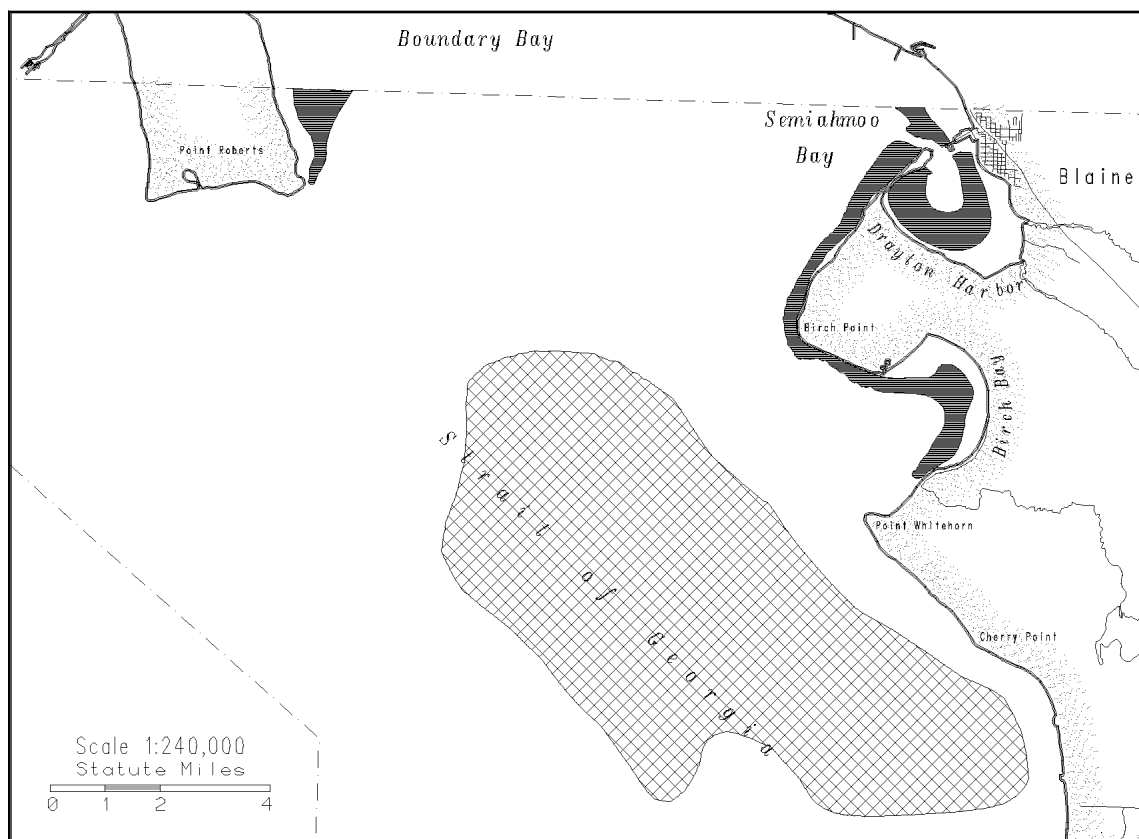
critical: 5% of 25 yr mean spawning biomass

Semiahmoo Bay Herring Stock

OVERVIEW

The Semiahmoo Bay herring stock is the northernmost stock in the Puget Sound basin. The stock's documented spawning grounds overlap with those of the spring spawning Cherry Point stock. However, biological characteristics such as growth rates, and spawning behavior such as time of spawning, differ markedly between the two stocks on a consistent basis.

SPAWNING GROUND



SPAWNING TIMING

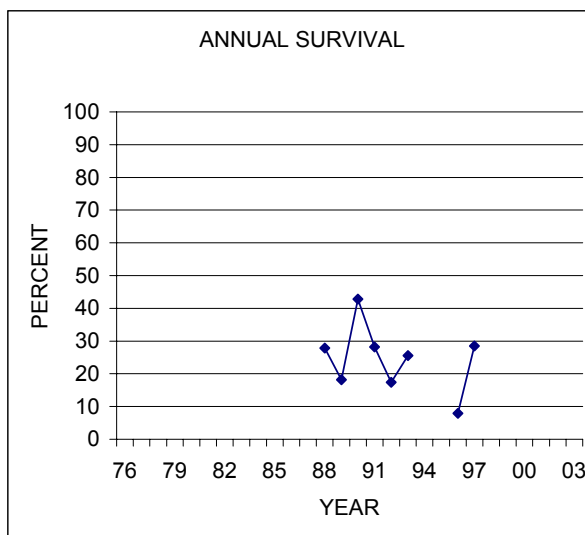
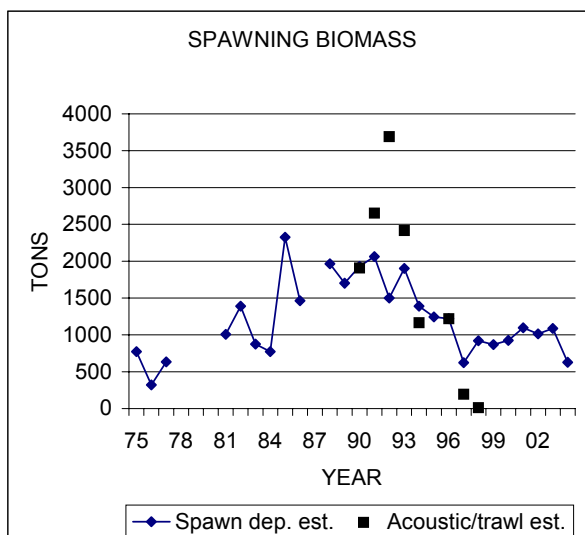
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
148mm/163mm/180mm/na (2000)

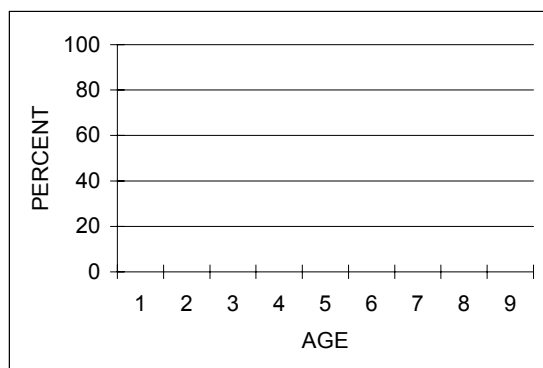
STOCK STATUS PROFILE for Semiahmoo Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75	772		772	
76	321		321	
77	634		634	
78				
79				
80				
81	1008		1008	
82	1389		1389	
83	874		874	
84	772		772	
85	2325		2325	
86	1464		1464	
87				
88	1965		1965	
89	1701		1701	978
90	1930	1909	1930	1573
91	2061	2655	2061	860
92	1501	3689	1501	636
93	1902	2416	1902	1554
94	1389	1166	1389	676
95	1245		1245	
96		1219	1219	
97	621	196	621	465
98	919	12	919	731
99	868		868	
2000	926		926	
2001	1098		1098	
2002	1012		1012	
2003	1087		1087	
2004	629		629	
MEAN:				
25 year	1304	1658	1300	
5 year	950		950	



2004 BIOMASS AGE COMPOSITION



no data

STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

fair

RECENT TREND (5 year)

stable

STOCK STATUS (2 year)

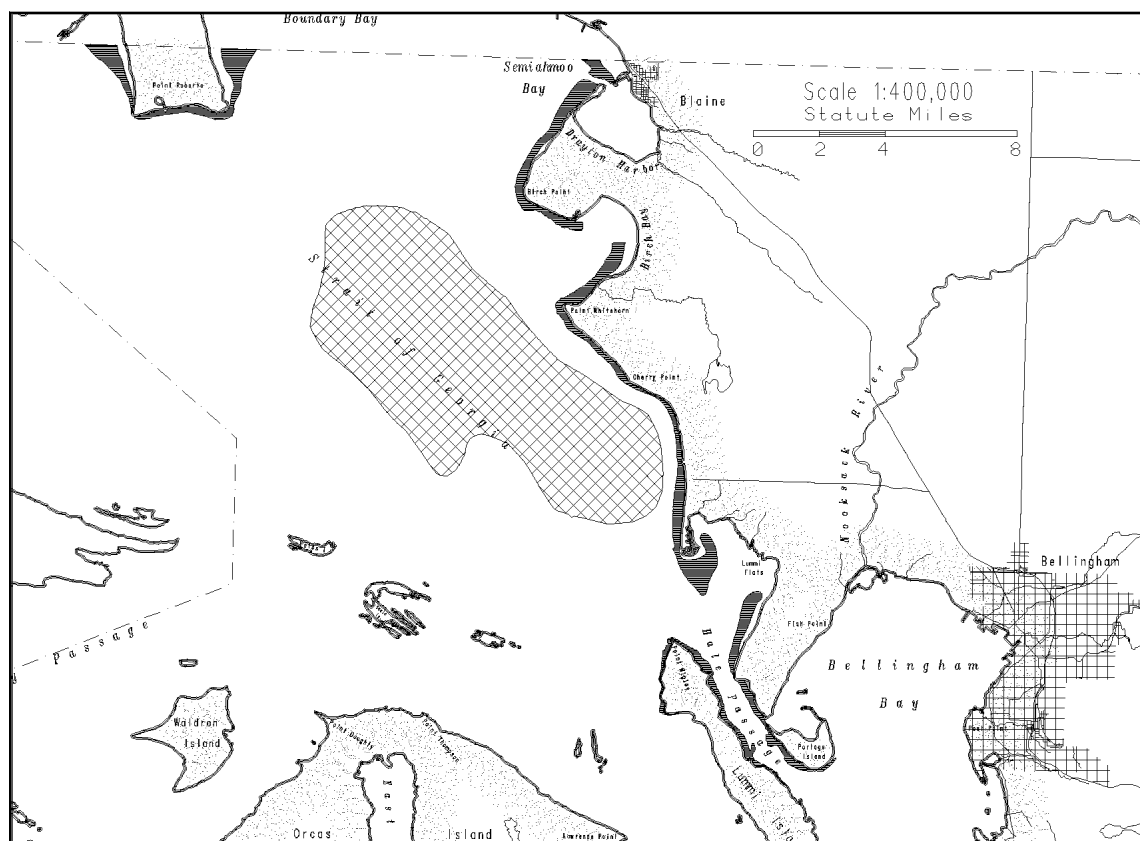
depressed: 66% of 25 yr mean spawning biomass

Cherry Point Herring Stock

OVERVIEW

The Cherry Point herring stock is unique in Washington State because of its exceptionally late spawning timing. The Cherry Point fish also exhibit relatively rapid growth after age 1; therefore, it is thought to likely be a “migrant” stock, possibly over summering off of the continental shelf. Washington’s largest herring stock from the 1970s until the mid-1990s, its abundance has decreased dramatically and it continues to be in critical condition. Recent DNA research suggests the Cherry Point stock is genetically distinct from British Columbia and other Puget Sound stocks sampled to date.

SPAWNING GROUND



SPAWNING TIMING



MEAN LENGTH OF 2/3/4/5 YEAR OLDS
161mm/186mm/201mm/213mm (2004)

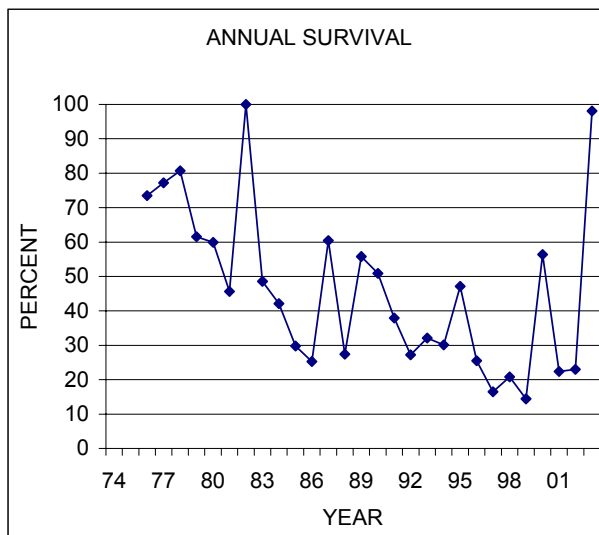
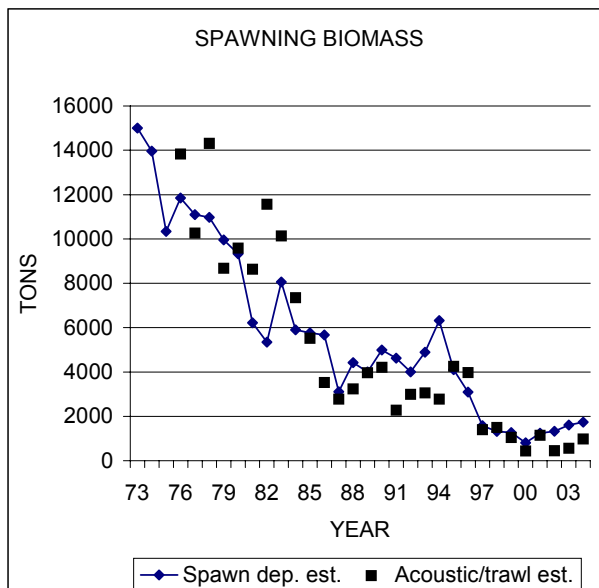
STOCK STATUS PROFILE for Cherry Point Herring Stock

STOCK ASSESSMENT

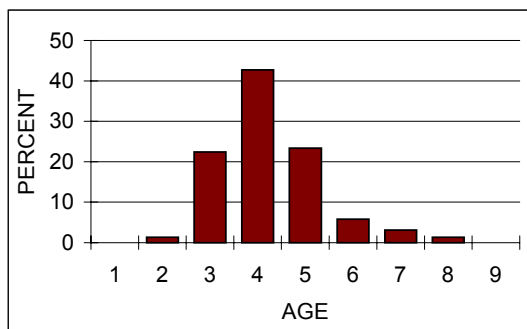
YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
73	14998		14998	
74	13963		13963	
75	10337		10337	1910
76	11844	13832	11844	1159
77	11097	10270	11097	3009
78	10973	14314	10973	3541
79	9957	8684	9957	1129
80	9329	9589	9329	3675
81	6219	8637	6219	397
82	5342	11562	5342	2043
83	8063	10142	8063	1385
84	5901	7347	5901	1001
85	5760	5519	5760	2928
86	5671	3528	5671	3295
87	3108	2775	3108	1155
88	4428	3236	4428	2080
89	4003	3963	4003	2497
90	4998	4215	4998	1901
91	4624	2278	4624	1141
92	4009	2998	4009	1991
93	4894	3055	4894	3434
94	6324	2777	6324	4076
95	4105	4251	4105	1204
96	3095	3971	3095	772
97	1574	1400	1574	645
98	1322	1502	1322	984
99	1266	1052	1266	890
2000	808	436	808	560
2001	1241	1146	1241	680
2002	1330	450	1330	974
2003	1611	555	1611	998
2004	1734	981	1734	22

MEAN:

25 year	4030	3895	4030
5 year	1345	714	1345



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

good

RECENT TREND (5 year)

increasing

STOCK STATUS (2 year)

critical: 41% of 25 yr mean spawning biomass

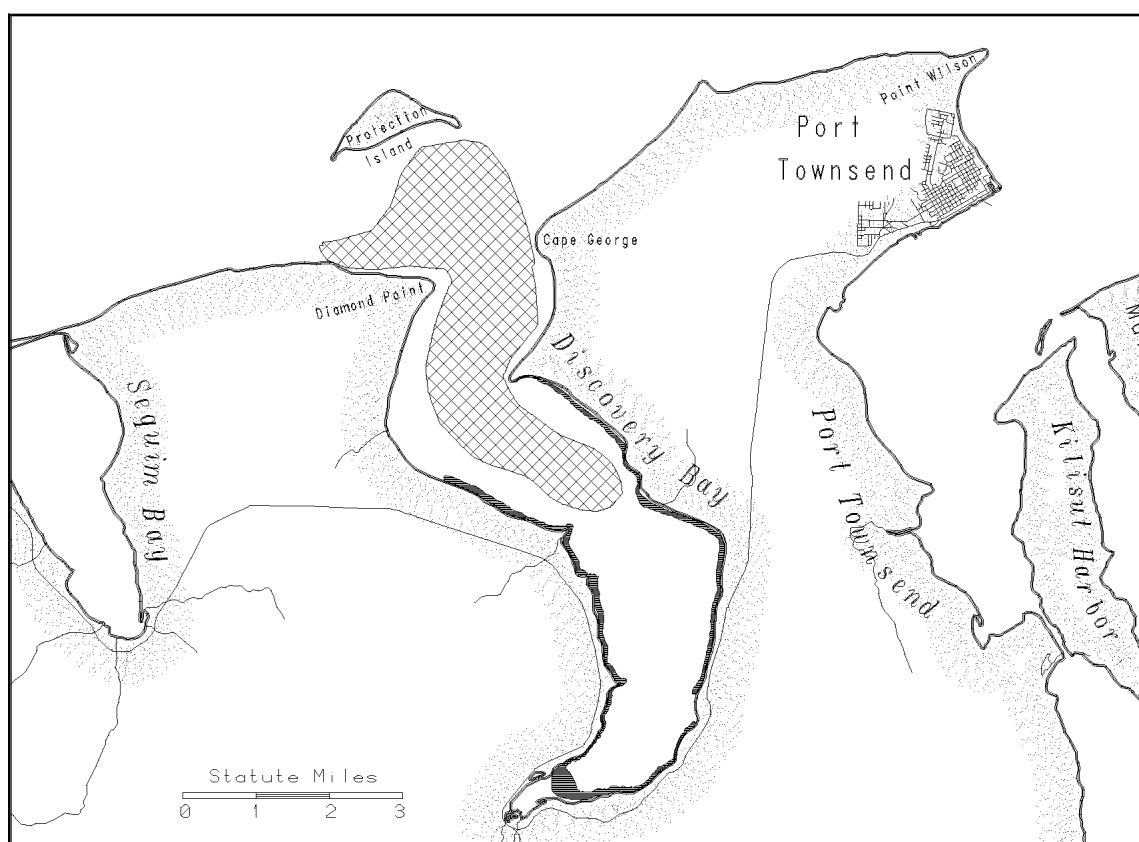
Strait of Juan De Fuca Herring Stock Profiles

Discovery Bay Herring Stock

OVERVIEW

The Discovery Bay herring stock is the major Strait of Juan de Fuca stock. The stock was the state's second largest in the early 1980s. Since that time its spawning biomass has dropped drastically and the stock is considered to be in critical condition. The stock has no known fishery interceptions and its spawning grounds are presumed to be among the most pristine in Washington. Increased pinniped predation from the adjacent Protection Island haul-out and/or straying to other spawning grounds are potential causes for biomass decline.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

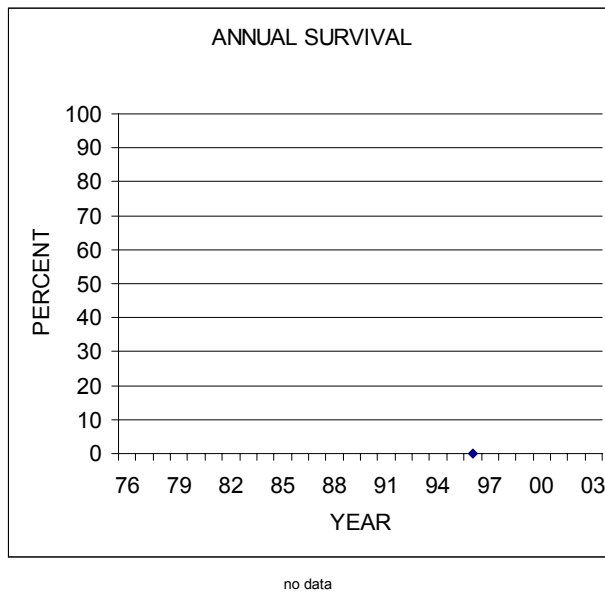
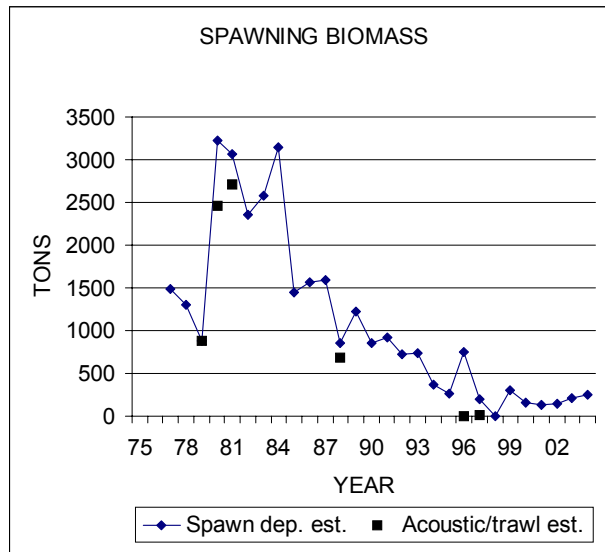
Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS
143mm/168mm/204mm/na (1997)

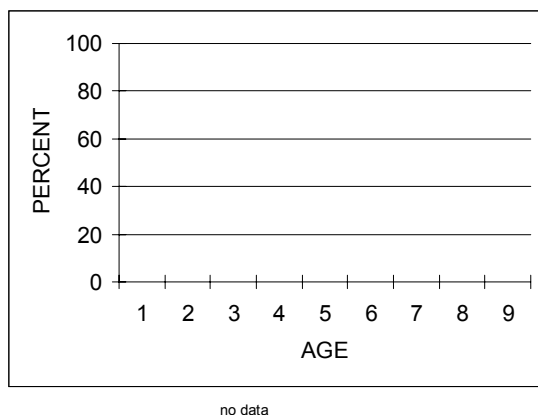
STOCK STATUS PROFILE for Discovery Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76	697			
77	1488		1488	
78	1305		1305	
79		882	882	
80	3220	2458	3220	
81	3070	2712	3070	
82	2356		2356	
83	2578		2578	
84	3144		3144	
85	1447		1447	
86	1566		1566	
87	1593		1593	
88	853	687	853	
89	1225		1225	
90	855		855	
91	925		925	
92	727		727	
93	737		737	
94	375		375	
95	261		261	
96	747	5	747	
97	199	19	199	
98	0		0	
99	307		307	
2000	159		159	
2001	137		137	
2002	148		148	
2003	207		207	
2004	252		252	
MEAN:				
25 year	1084	1176	1084	
5 year	181		181	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

fair

RECENT TREND (5 year)

increasing

STOCK STATUS (2 year)

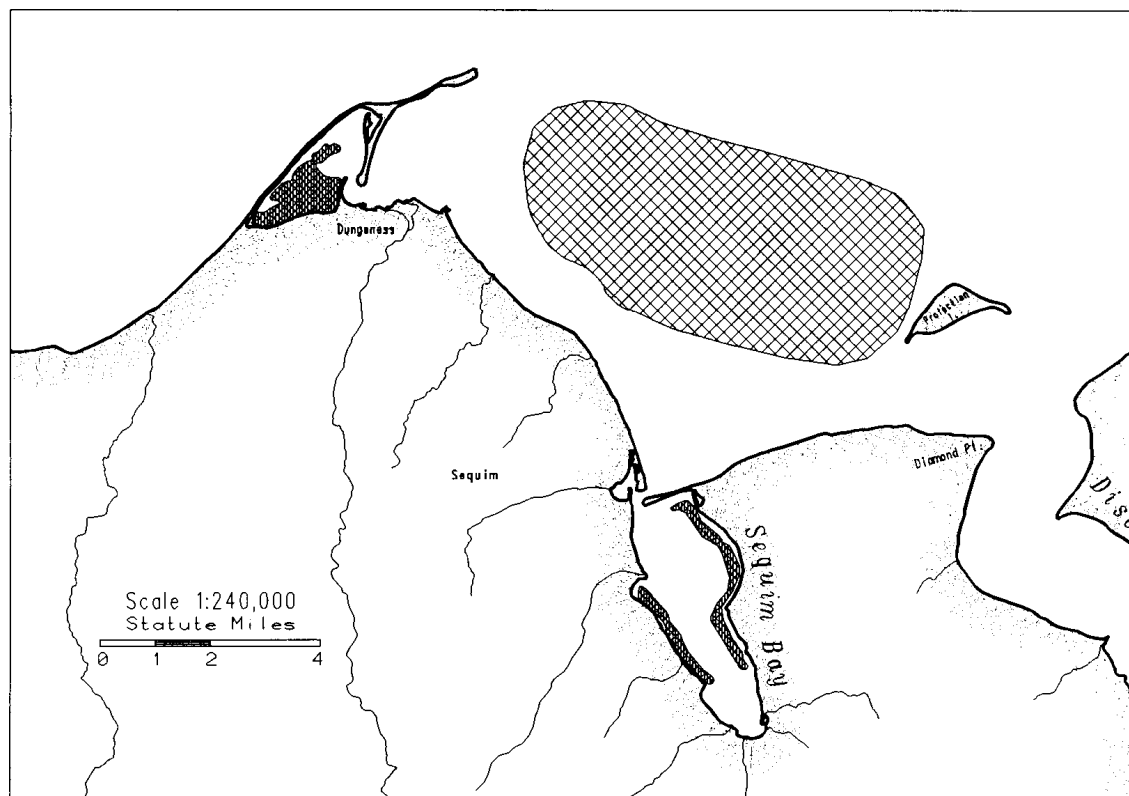
critical: 21% of 25 yr mean spawning biomass

Dungeness/Sequim Bay Herring Stock

OVERVIEW

The Dungeness Bay portion of this small stock's spawning grounds hosts most, if not all, of its spawning activity. These spawning grounds are the westernmost grounds used by any Puget Sound stock. Despite the presence of abundant marine vegetation preferred for spawning in Sequim Bay, only one small spawning event has been documented there since 1994. A decrease in available spawning substrate has been observed in Dungeness Bay in recent years.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

Jan	Feb	March	April	May	June

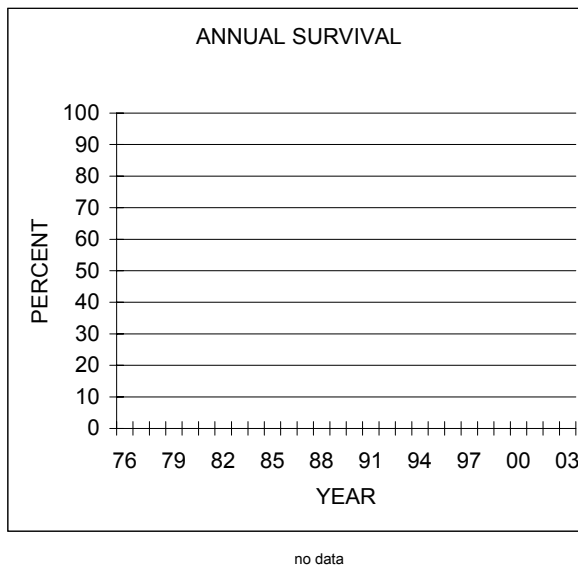
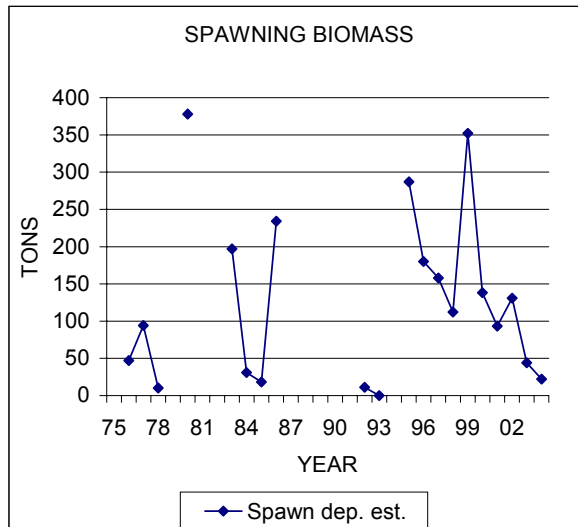
MEAN LENGTH OF 2/3/4/5 YEAR OLDS

No data

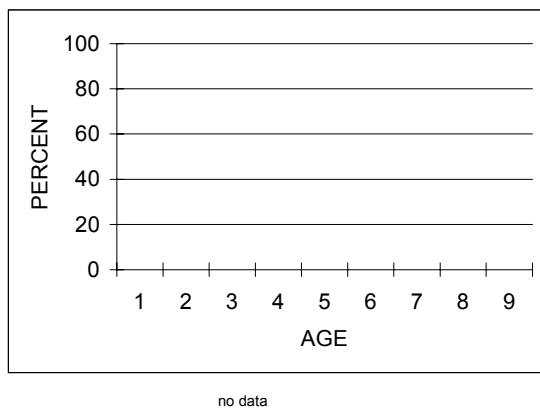
STOCK STATUS PROFILE for Dungeness/Sequim Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76		47	47	
77		94	94	
78		10	10	
79				
80		378	378	
81				
82				
83		197	197	
84		31	31	
85		18	18	
86		234	234	
87				
88				
89				
90				
91				
92		11	11	
93		0 (partial survey coverage)	0	
94				
95		287	287	
96		180	180	
97		158	158	
98		112	112	
99		352	352	
2000		138	138	
2001		93	93	
2002		131	131	
2003		44	44	
2004		22	22	
MEAN:				
25 year		140	140	
5 year		86	86	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY

no fishery

DATA QUALITY

poor

RECENT TREND (5 year)

decreasing

STOCK STATUS (2 year)

depressed: 24% of 25 yr mean spawning biomass

Puget Sound Herring Stock Status Summary

1994, 1996, 1998, 2000, 2002, and 2004

The most recent herring status of stocks document produced by WDFW included results through 1996 (Lemberg et al. 1997). The table on the next page includes stock status summaries since 1994 based on 2-year mean spawning biomass estimates and status classification criteria described on page 6 of this report.

For the 2003-04 period, 50% of Puget Sound herring stocks are classified as healthy or moderately healthy. This is the lowest percentage of stocks meeting these criteria since development of the stock status summary in 1994; following 71% and 83% of stocks considered healthy or moderately healthy in 2000 and 2002, respectively. One stock, N.W. San Juan Island, was also added to the critical list in 2004.

Regionally, south/central Puget Sound stocks have maintained a healthy stock status since the first evaluation in 1994. Conversely, north Puget Sound's combined status has moved from healthy in 1994, to moderately healthy in 1996, and depressed since 1998; largely due to the decrease in spawning biomass for the Cherry Point stock. The Strait of Juan de Fuca region's status has been consistently classified as critical since 1994, primarily due to the condition of the Discovery Bay stock, which has remained at a very low level of abundance.

Recent genetic research results mentioned previously in this report would support a cumulative non-Cherry Point spawning biomass comparison. The spawning biomass for all Puget Sound stocks combined, excluding the Cherry Point stock, would be considered healthy compared to the previous 25-year mean; the 2003-04 mean cumulative spawning biomass for those stocks is 11,839 tons and the previous 25-year mean is 11,105 tons.

STOCK STATUS - Describes a stock's current condition based primarily on recent (previous 2 year mean) abundance compared to long-term (previous 25 year mean) abundance. Stock criteria such as survival, recruitment, age composition, and spawning ground habitat condition are also considered.

HEALTHY - A stock with recent two year mean abundance above or within 10% of the 25 year mean.

MODERATELY HEALTHY - A stock with recent two year mean abundance within 30% of the 25 year mean, and/or with high dependence on recruitment.

DEPRESSED - A stock with recent abundance well below the long term mean, but not so low that permanent damage to the stock is likely (i.e., recruitment failure).

CRITICAL - A stock with recent abundance so low that permanent damage to the stock is likely or has already occurred (i.e., recruitment failure).

EXTINCT - A stock which can no longer be found in a formerly consistently utilized spawning ground.

UNKNOWN - Insufficient assessment data to identify stock status with confidence.

Region	Stock	2004	2002	2000	1998	1996	1994
South-Central Puget Sound		HEALTHY	HEALTHY	HEALTHY	HEALTHY	HEALTHY	HEALTHY
	Squaxin Pass	HEALTHY	HEALTHY	HEALTHY	MOD. HEALTHY	MOD. HEALTHY	MOD. HEALTHY
	Wollochet Bay	UNKNOWN	UNKNOWN				
	Quartermaster Harbor	MOD. HEALTHY	MOD. HEALTHY	HEALTHY	HEALTHY	HEALTHY	HEALTHY
	Port Orchard-Madison	MOD. HEALTHY	HEALTHY	HEALTHY	DEPRESSED	DEPRESSED	DEPRESSED
	South Hood Canal	MOD. HEALTHY	MOD. HEALTHY	HEALTHY	MOD. HEALTHY	UNKNOWN	UNKNOWN
	Quilcene Bay	HEALTHY	HEALTHY	HEALTHY	HEALTHY	HEALTHY	UNKNOWN
	Port Gamble	DEPRESSED	MOD. HEALTHY	HEALTHY	DEPRESSED	HEALTHY	HEALTHY
	Kilisnoe Harbor	MOD. HEALTHY	HEALTHY	HEALTHY	MOD. HEALTHY	UNKNOWN	HEALTHY
	Port Susan	DEPRESSED	MOD. HEALTHY	MOD. HEALTHY	HEALTHY	DEPRESSED	MOD. HEALTHY
	Holmes Harbor	HEALTHY	HEALTHY	DEPRESSED	HEALTHY	UNKNOWN	UNKNOWN
	Skagit Bay	HEALTHY	HEALTHY	MOD. HEALTHY	MOD. HEALTHY	HEALTHY	UNKNOWN
North Puget Sound		DEPRESSED	DEPRESSED	DEPRESSED	DEPRESSED	MOD. HEALTHY	HEALTHY
	Fidalgo Bay	DEPRESSED	HEALTHY	HEALTHY	HEALTHY	MOD. HEALTHY	MOD. HEALTHY
	Samish/Portage Bay	MOD. HEALTHY	HEALTHY	HEALTHY	HEALTHY	HEALTHY	MOD. HEALTHY
	Interior San Juan Is.	DEPRESSED	MOD. HEALTHY	DEPRESSED	UNKNOWN	UNKNOWN	UNKNOWN
	N.W. San Juan Is.	CRITICAL	DEPRESSED	UNKNOWN	DEPRESSED	UNKNOWN	UNKNOWN
	Semiahmoo Bay	DEPRESSED	MOD. HEALTHY	DEPRESSED	DEPRESSED	HEALTHY	HEALTHY
Cherry Point		CRITICAL	CRITICAL	CRITICAL	CRITICAL	DEPRESSED	MOD. HEALTHY
Strait of Juan de Fuca		CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL
Discovery Bay		CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL	CRITICAL
	Dungeness/Sequim Bay	DEPRESSED	MOD. HEALTHY	HEALTHY	HEALTHY	HEALTHY	UNKNOWN
Puget Sound Combined		MOD. HEALTHY	HEALTHY	MOD. HEALTHY	MOD. HEALTHY	MOD. HEALTHY	HEALTHY
2004/2002/2000/1998/1996/1994 Individual Stock Comparison							
HEALTHY		4 stocks	8 stocks	10 stocks	7 stocks	7 stocks	4 stocks
MOD. HEALTHY		5 stocks	7 stocks	2 stocks	3 stocks	2 stocks	5 stocks
DEPRESSED		6 stocks	1 stock	3 stocks	5 stocks	3 stocks	1 stock
CRITICAL		3 stocks	2 stocks	2 stocks	2 stocks	1 stock	1 stock
EXTINCT		0 stocks	0 stocks	0 stocks	0 stocks	0 stocks	0 stocks
UNKNOWN		1 stock	1 stock	1 stock	1 stock	5 stocks	7 stocks
		50%	83%	71%	59%	69%	82%
Healthy or			Healthy or	Healthy or	Healthy or	Healthy or	Healthy or
Mod. Healthy			Mod. Healthy	Mod. Healthy	Mod. Healthy	Mod. Healthy	Mod. Healthy

Puget Sound Herring Spawning Biomass Estimates, 1976-2004

The herring spawning biomass estimates for individual stocks presented in the stock profiles demonstrate the large annual fluctuations that commonly occur in herring populations. Particularly given the question of what constitutes a “stock” for Puget Sound herring, a valuable indicator of population condition is a cumulative spawning biomass estimate by region and/or Puget Sound as a whole.

By management region, the south/central Puget Sound combined stock spawning biomass has shown a general increase since 1997. Sampling effort (number of stocks surveyed each year) has affected the cumulative estimate, but most stocks in this region are at relatively high levels of abundance based on estimates made in the last 25 years. The Squaxin Pass and Quilcene Bay stocks, in particular, have had large annual spawning biomass estimates in recent years.

Fluctuation in the size of the Cherry Point herring stock has been the primary factor influencing the cumulative spawning biomass for the north Puget Sound region. The north Puget Sound cumulative spawning biomass was easily the state’s largest when quantitative estimates were begun by WDFW in the early 1970s and continued until the mid-1980s when a significant decline in the size of the Cherry Point stock occurred. A gradual increase was observed from 1988-94, followed by a rapid decrease from 1995 to 2000. The stock reached its lowest abundance in 2000 (808 tons) and has gradually increased to 1734 tons in 2004. The Fidalgo Bay and Semiahmoo Bay stocks are generally the next largest stocks for this region; although not mirroring the dramatic decline observed for the Cherry Point stock, both of these stocks are currently considered to be depressed, based on estimated spawning biomass for 2003-04.

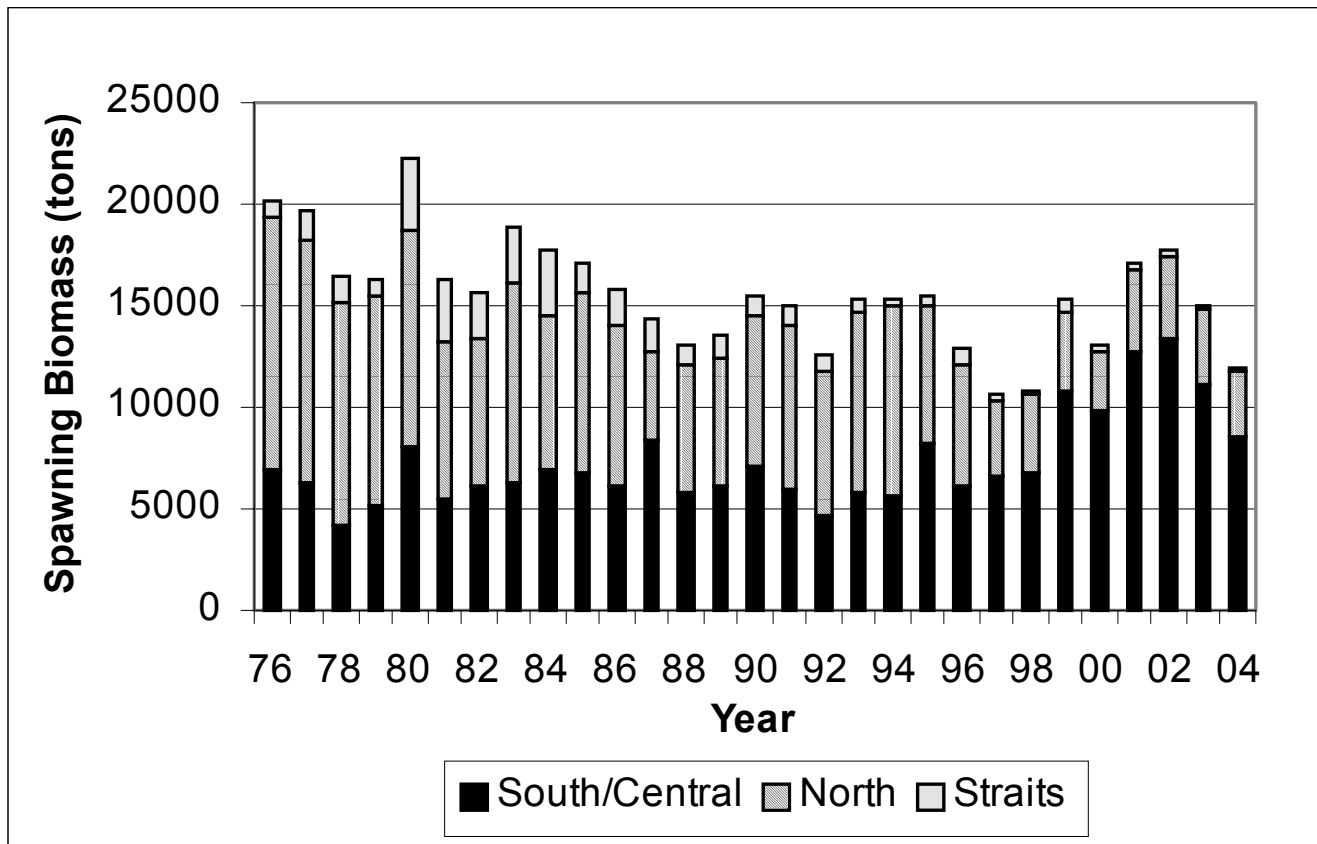
The primary herring stock for the Strait of Juan de Fuca region is the Discovery Bay stock. This stock’s abundance was high in the early 1980s, with an estimated spawning biomass exceeding 3,000 tons in 1980, 1981, and 1984. A steady decline in estimated spawning biomass has been observed since 1985, with no documented spawning escapement in 1998, and estimated spawning biomass of 307 tons or less since 1998. Potential cause(s) for this decline include increased natural mortality due to increased predator abundance (e.g., harbor seals and Pacific hake) abundance or a shift in spawning location to other grounds in Puget Sound or British Columbia.

The mean cumulative spawning biomass for Puget Sound combined for 1980-2004 is 15,135 tons. This figure is based on the sum of annual spawning biomass estimates from surveyed stocks. Thus, inconsistent sample effort (number of stocks surveyed) would bias comparisons. The combined sum of previous 25-year (1980-2004) mean annual spawning biomass estimates by stock for all Puget Sound stocks provides a total of 17,754 tons. The 2003 (15,016 tons) and 2004 (12,007 tons) cumulative spawning biomass estimates are 15% and 32%, respectively, less than the previous 25-year mean.

A comparison of regional combined sum of previous 25-year (1980-2004) mean annual spawning biomass estimates to recent regional cumulative biomass estimates provides similar

conclusions to those mentioned above: south/central Puget Sound spawning biomass abundance is above average; north Puget Sound is below average; and the Straits region abundance is far below average.

Puget Sound Herring Cumulative Spawning Biomass Estimates, 1976-2004



Summary of Puget Sound Herring Fisheries

Commercial herring fisheries in Puget Sound have experienced several major shifts since the start of the last century as described in detail by Trumble (1983) and Williams (1959).

Commercial herring fisheries in the early 1900s harvested herring mainly for export, a market that collapsed soon after World War I. During this time purse seines, drag seines, and traps targeted herring with most of the catch coming from Hale Pass (north Puget Sound), Holmes Harbor, Birch Bay, Poulsbo, and Discovery Bay.

From the 1920s through the 1940s the major portion of herring landings were used as bait for commercial halibut, crab, and shark fisheries. Herring traps accounted for much of the landings beginning in the 1920s. Traps were typically located adjacent to or near spawning grounds to intercept adult fish migrating to and from spawning areas. The most successful trap sites were the southwest shore of Holmes Harbor and at Point Whitney near Quilcene Bay in Hood Canal. Total reported herring landings through the 1940s ranged from a low of 36 tons in 1942 to a high of 1,311 tons in 1926 (Chapman et al. 1941 and Williams, 1959).

By the early 1950s, commercial herring fishing emphasis in Puget Sound shifted again to primarily supply bait to growing recreational salmon fisheries. Changing market conditions and trap location restrictions in 1937 decreased the number of operational herring traps to one (in Holmes Harbor) by 1947 and led to a gradual reduction in trap landings, the last of which occurred in 1971.

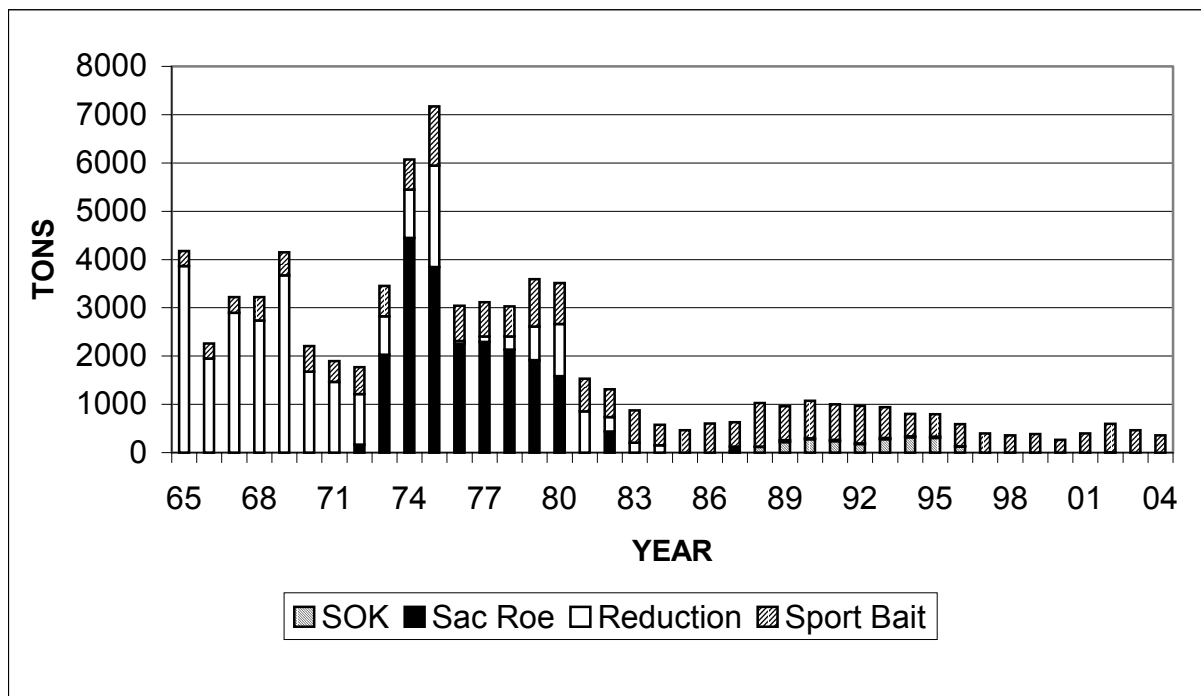
The next shift in the Puget Sound herring fishery happened in 1957 when the reduction of herring to oil and meal was authorized. This led to a sizable fishery in north Puget Sound, with landings from 1,500 to 3,500 tons. This fishery was phased out in the early 1980s due to concerns about local stock abundance.

In 1972, a sac-roe fishery targeting the Cherry Point stock began. Landings in this treaty and non-treaty fishery topped 4,000 tons in 1974. Declines in the north Puget Sound herring stocks, particularly the Cherry Point stock, led to the closure of both the reduction and sac-roe fisheries by the mid-1980s. In 1988, an all citizens spawn-on-kelp and treaty sac-roe fisheries were resumed on the Cherry Point stock. Another decline in Cherry Point stock abundance in the mid-1990s again closed this fishery and has remained closed to date. A minimum spawning biomass of 3,200 tons for the Cherry Point stock is currently required before harvest is considered.

The only current commercial herring fishery operating in Puget Sound provides bait for sport salmon and groundfish fisheries. Fishing activity is primarily in south and central Puget Sound and mostly targets on 1½-year old “plug-sized” herring assumed to be an aggregate of stocks within the region. Most of the harvest is taken by non-tribal fishers using relatively small lampara seines. The recent size of annual landings by this fishery are generally determined by market conditions, which are heavily influenced by the length of recreational salmon seasons. Similarly, Williams (1959) and Chapman et al. (1941) reported that herring landings are affected most by variability of fishing effort and that annual catch figures are not a reliable indicator of herring abundance.

Annual landings by the herring sport bait fishery for the last ten years (1995-2004) have averaged 414 tons, ranging from a low of 265 tons in 2000 to a high of 592 tons in 2002. The annual maximum harvest guideline is set at 10% of average adult biomass in the region. Landings for 1995-2004 did not reach the harvest guideline, ranging from 3% to 8% of the sum of mean adult spawning biomass estimates for south/central Puget Sound stocks for the same time period.

Puget Sound Herring Landings by Fishery Type, 1965-2004



Natural Mortality

The size of Puget Sound herring populations is impacted significantly by mortality rates. Mortality can be attributed to two types: fishing and natural mortality (all causes other than human harvest).

Fish survival and mortality are often expressed in terms of rates or percentages. The survival rate is the number of fish alive after a specified time (usually yearly), divided by the initial number. The mortality rate, based on the number of fish not surviving, is equal to 1 minus the survival rate (e.g., an annual survival rate of 35% would produce an annual mortality rate of 65%). Adult herring mortality rates of 30-40% are considered typical for herring worldwide (Lemberg et al. 1997).

Adult herring mortality and survival has been estimated for the Cherry Point stock since 1976. Additional stocks were included in mortality estimates beginning in 1987 when acoustic/trawl survey effort was increased. The figure below shows estimates of annual tonnages of herring in Puget Sound determined by natural mortality/survival rates, fishery harvest, and cumulative spawning biomass. The mortality rate estimate used includes all available results for that year (Cherry Point stock only prior to 1987; up to 14 individual stock estimates since 1987). It is assumed that the cumulative spawner biomass estimate is reflective of total spawner biomass and that complete discreteness exists between sampled stocks.

The annual mortality rate estimate for the Cherry Point herring stock has increased from a range of 20-40% in the late 1970s to around 70% from 1990 through 2002. Interestingly, the estimated natural mortality rate for the Cherry Point stock for 2003 was only 2%, due to increased survival of older ages coupled with relatively low recruitment of 2- and 3-year old fish. Limited sampling that may not have been representative of the spawning population may also have affected the estimated natural mortality rate for 2003. The mean estimated annual natural mortality rate for other sampled stocks since 1987 has averaged 71%; as mentioned above, high for herring populations. Fishing mortality since 1997 has averaged about 4% of estimated natural mortality.

The increase in adult natural mortality has resulted in a decrease in the mean and median age of adult herring in Puget Sound. Relatively good recruitment has sustained most stocks despite the high natural mortality observed.

Potential causes of increased natural mortality include predation, disease, and climatic changes. NMFS (1997) estimated that the harbor seal (*Phoca vitulina*) population in all Washington waters increased 7.7% annually between 1978 and 1993 and the harbor seal population in inland waters of Washington more than doubled from 7,380 in 1983 to 15,634 in 1993 (WDFW and National Marine Mammal Laboratory data reported by West 1997). Herring are among the primary pinniped prey species in Washington (Schmitt et al. 1995) and herring comprised 32.6% of harbor seal diet in the Canadian Strait of Georgia in 1988 (Olesiuk et al. 1990).

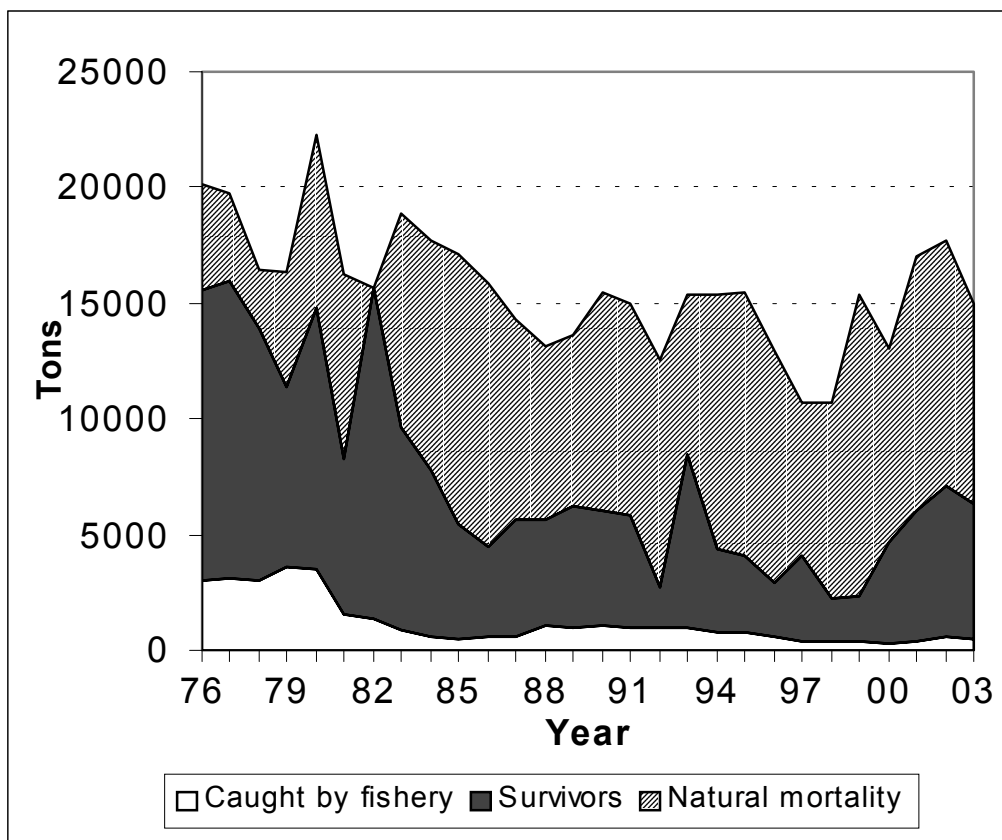
A protozoan parasite, *Ichthyophonus hoferi*, that can be highly pathogenic to Pacific herring (Kocan et al. 1999) and has caused repeated epidemics among Atlantic herring (reviewed in

Sindermann 1990, Rahmimian and Thulin 1996), is currently ubiquitous among Pacific herring populations in Washington and British Columbia (Hershberger et al. 2002 and Jones and Dawe 2002). Incidence of *I. hoferi* infection in Washington herring has been shown to increase with age and it is possible that infections are associated to the observed increased herring natural mortalities.

Changes in sea temperatures can have direct and indirect impacts on herring survival. The observed decline of the Cherry Point stock since the mid-1970s coincided with warmer/drier than average conditions in the Pacific Northwest (Stout et al. 2001). Chapman et al. (1941) considered Cherry Point and Discovery Bay populations to be at low levels in the 1930s when similar climatic conditions occurred. Conditions shifted back to cold/wet or average during the 1940s and 1950s. Williams (1959) reported that among others, the Cherry Point and Discovery Bay populations had returned to relatively high levels of abundance during those decades.

Warmer than average water temperatures, particularly during the time of spawn incubation and larval stages, could have a direct negative impact on herring survival. Potential indirect effects of warmwater conditions include an increase in predation by species such as Pacific hake (*Merluccius productus*). Larger numbers of hake migrate to the west coast of Vancouver Island during warm summers to forage (Ware and McFarlane 1995) and herring stocks that migrate to coastal waters may experience higher predation/natural mortality at these times.

Natural and Fishery Mortality of Puget Sound Herring Stocks, 1976-2003



Coastal Herring Stock Profiles

Coastal Herring Summary

Introduction

Spawning populations of Pacific herring are documented in the coastal embayments of Willapa Bay and Grays Harbor. Initial documentation of spawning activity for Grays Harbor occurred in 1998 and has been observed annually since that time. Herring stock assessment by WDFW has traditionally been focused on presumed larger Puget Sound stocks and limited assessment of coastal herring stocks currently takes place.

Spawning Timing/Grounds

Herring spawning activity has been observed in February and March in Willapa Bay and February through March in Grays Harbor. Most of the spawn deposition in Grays Harbor appears to occur in the South Bay/Elk River estuary area of south Grays Harbor.

Lassuy (1989) indicated that Pacific herring spawn in the Columbia River estuary; limited sampling by WDFW has not confirmed spawning activity there.

Stock Identification

Little is known about the coastal herring populations. However, due to the geographical separation of their spawning grounds, the Willapa Bay and Grays Harbor spawning populations are considered to be discrete for the purposes of this report.

Herring spawned in coastal locations are likely components of large summer herring aggregations that concentrate in coastal offshore areas including the western end of the Strait of Juan de Fuca and the west coast of Vancouver Island.

Stock Status

The limited information available for the coastal herring populations indicates that they are currently at a relatively high level of abundance. However, sampling effort for these areas has been sporadic. Available spawning biomass estimates for both stocks are 400 tons or less. Adverse weather conditions and equipment malfunctions in 2004 caused incomplete survey coverage for coastal spawning grounds.

Fisheries

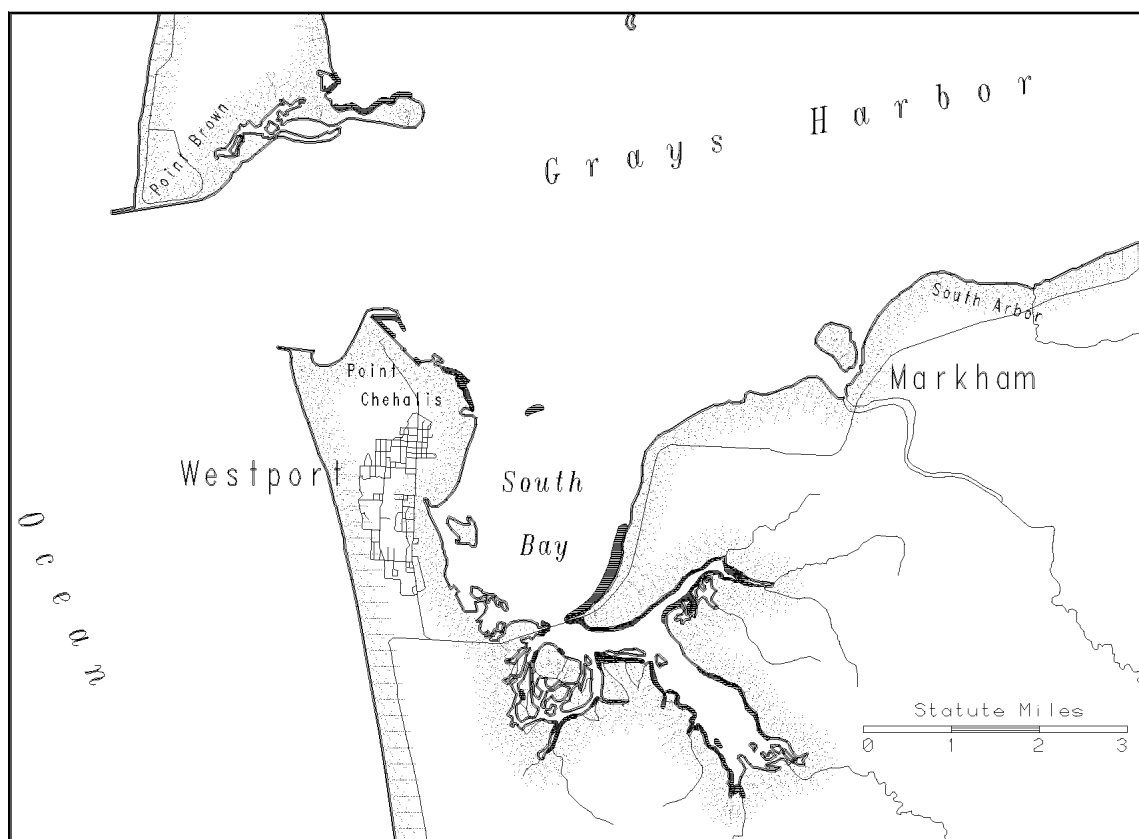
Reported fishery landings of seven tons or less have occurred since 1999 for bait herring caught in Willapa Bay and Grays Harbor. No directed herring fishery harvest is allowed in Washington's coastal waters.

Grays Harbor Herring Stock

OVERVIEW

Herring spawn deposition was first documented in Grays Harbor in 1998 and has been observed annually since. A limited amount of spawning activity has been confirmed in the Point Damon area of north Grays Harbor, but most of the stock's spawn deposition has been observed in the South Bay/Elk River estuary vicinity. Much of the spawn deposition is deposited relatively high along the intertidal salt marsh edges on a mix of vascular plants and marine algae.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

Jan	Feb	March	April	May	June

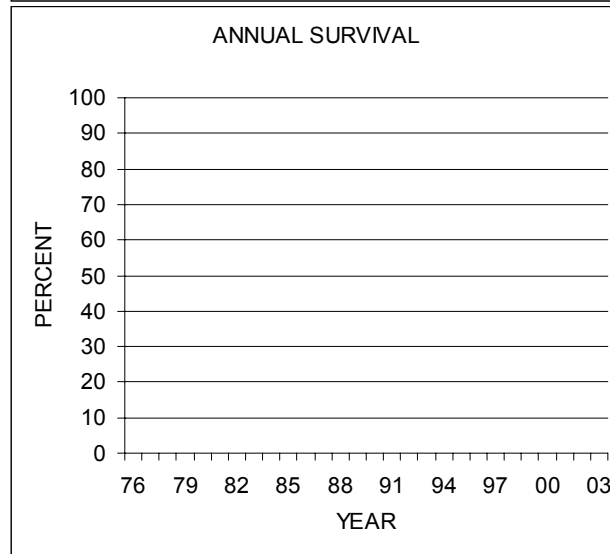
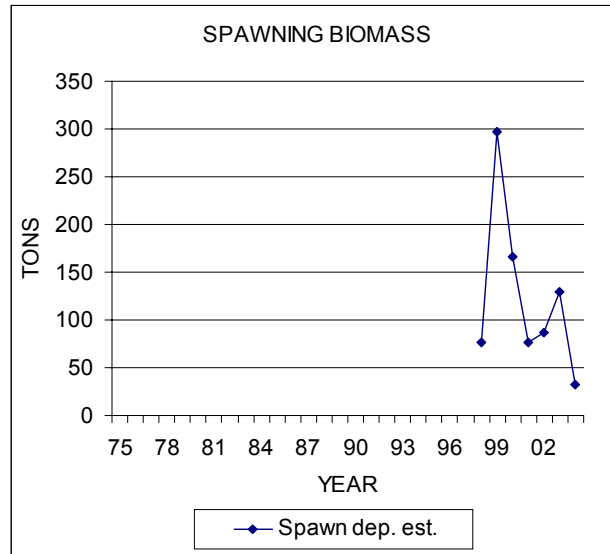
MEAN LENGTH OF 2/3/4/5 YEAR OLDS

No data

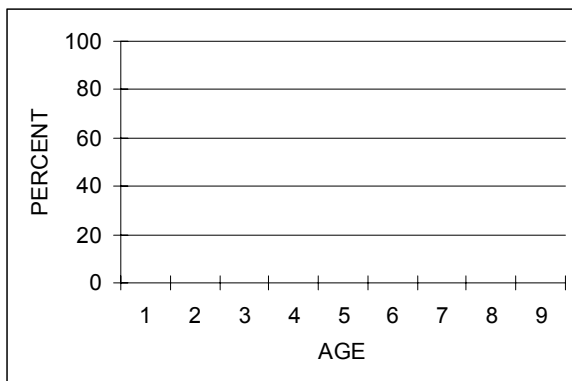
STOCK STATUS PROFILE for South Grays Harbor Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98		77	77	
99		297	297	
2000		166	166	
2001		77	77	
2002		87	87	
2003		129	129	
2004		33 (partial survey coverage)	33	
MEAN:				
25 year		124	124	
5 year		132	132	



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY
no fishery

DATA QUALITY
poor

RECENT TREND (5 year)
insufficient data

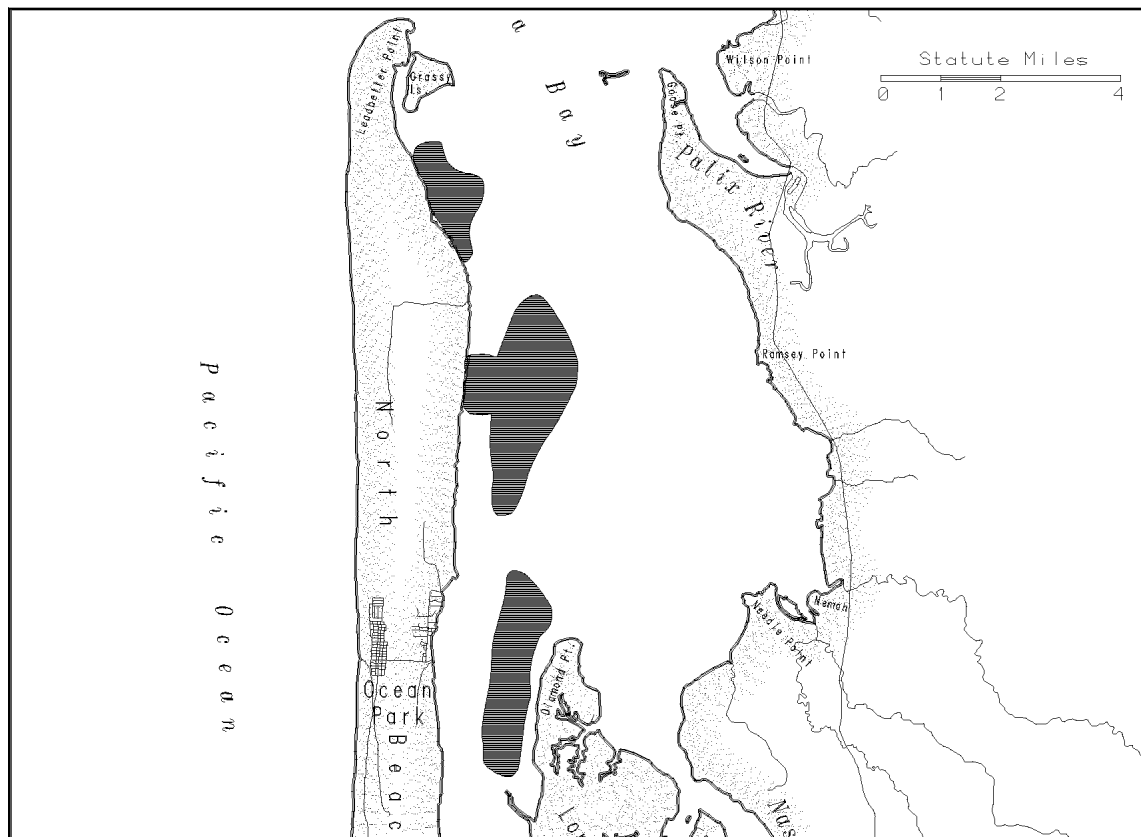
STOCK STATUS (2 year)
insufficient data

Willapa Bay Herring Stock

OVERVIEW

Based on limited survey effort, recent spawning biomass for the Willapa Bay herring stock appears to be at a relatively high level. Documented spawning grounds are limited to the southern portion of the bay. Little is known about this stock's life history, although it is likely that these fish spend significant time in ocean waters.

SPAWNING GROUND



Documented spawning ground



Prespawner holding area

SPAWNING TIMING

Jan	Feb	March	April	May	June

MEAN LENGTH OF 2/3/4/5 YEAR OLDS

No data

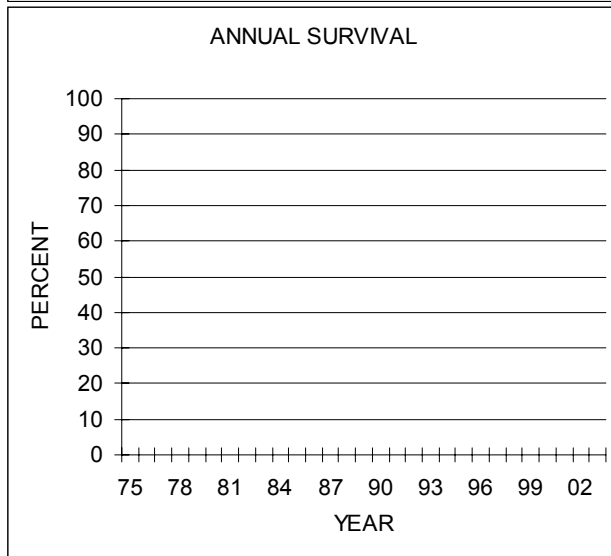
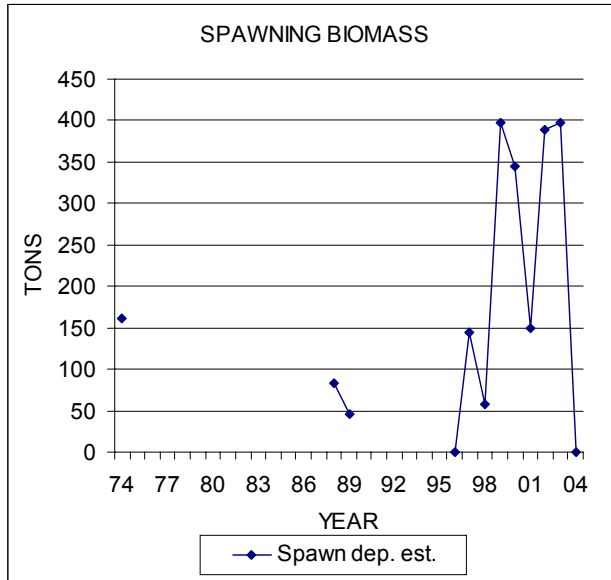
STOCK STATUS PROFILE for Willapa Bay Herring Stock

STOCK ASSESSMENT

YEAR	SPAWNING BIOMASS (tons)			RECRUITMENT (tons)
	SPAWN DEPOSITION SURVEYS	ACOUSTIC/ TRAWL SURVEYS	FINAL BIOMASS ESTIMATE	
74	162		162	
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88	83		83	
89	46		46	
90				
91				
92				
93				
94				
95				
96	0 (partial survey		0	
97	144 coverage)		144	
98	57		57	
99	397		397	
2000	345		345	
2001	150		150	
2002	389		389	
2003	398		398	
2004	0 (partial survey		0	
	coverage)			

MEAN:

25 year	183	183
5 year	256	256



2004 BIOMASS AGE COMPOSITION



STOCK SUMMARY

2004 SPAWNER FISHERY SUMMARY
no fishery

DATA QUALITY
poor

RECENT TREND (5 year)
insufficient data

STOCK STATUS (2 year)
insufficient data

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Appendix A. Estimated biomass in short tons (2000 lbs/ton) and number (millions of fish) at age of spawner herring by stock by year.

SQUAXIN PASS STOCK		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
1975	Tons at Age	1	4	14	45	145	52	30	3	298
	N at Age	0.031	0.050	0.151	0.480	1.350	0.469	0.220	0.031	2.790
	N Caught	0	0	0	0	0	0	0	0	
1976	no age data									2138
1977	Tons at Age	9	10	0	0	0	0	0	0	20
	N at Age	0.001	0.081	0.032	0.049	0.071	0.038	0.010	0.001	0.282
	N Caught	0	0	0	0	0	0	0	0	
1978	Tons at Age	12	11	26	2	3	1	1	2	58
	N at Age	0.241	0.124	0.208	0.011	0.016	0.010	0.007	0.009	0.625
	N Caught	0	0	0	0	0	0	0	0	
1981	Tons at Age	118	478	85	12	47	16	0	13	772
	N at Age	2.366	6.109	0.542	0.067	0.266	0.067	0.000	0.067	9.500
	N Caught	0	0	0	0	0	0	0	0	
1990	Tons at Age	58	497	11	0	0	0	0	0	566
	N at Age	1.233	9.339	0.159	0	0	0	0	0	10.731
	N Caught	0	0	0	0	0	0	0	0	
1991	Tons at Age	439	409	94	0	0	0	0	0	943
	N at Age	12.459	7.706	1.485	0	0	0	0	0	21.65
	N Caught	0	0	0	0	0	0	0	0	
1992	Tons at Age	70	227	381	89	5	0	0	0	771
	N at Age	1.583	3.858	5.342	1.060	0.036	0	0	0	11.879
	N Caught	0	0	0	0	0	0	0	0	
1995	Tons at Age	62	79	14	2	1	0	0	0	157
	N at Age	1.205	1.0048	0.157	0.023	0.008	0	0	0	2.3978
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	129	212	33	0	0	0	0	0	374
	N at Age	2.598	3.107	0.368	0.000	0.000	0	0	0	6.073
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	107	37	5	0	0	0	0	0	149
	N at Age	2.156	0.482	0.051	0.000	0.000	0	0	0	2.689
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	22	36	10	0	0	0	0	0	68
	N at Age	0.437	0.502	0.115	0.000	0.000	0	0	0	1.054
	N Caught	0	0	0	0	0	0	0	0	
1999	Tons at Age	338	114	21	0	0	0	0	0	474
	N at Age	7.188	1.651	0.226	0.000	0.000	0	0	0	9.065
	N Caught	0	0	0	0	0	0	0	0	
2000	Tons at Age	220	149	3	0	0	0	0	0	371
	N at Age	4.333	2.792	0.045	0.000	0.000	0	0	0	7.17
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	1119	439	38	0	0	0	0	0	1597
	N at Age	31.545	8.301	0.535	0.000	0.000	0	0	0	40.381
	N Caught	0	0	0	0	0	0	0	0	

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	
2002	Tons at Age	189	2498	466	0	0	0	0	0	3150
	N at Age	4.278	49.350	7.660	0.000	0.000	0	0	0	61.288
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	70	1127	850	119	35	0	0	0	2201
	N at Age	1.743	21.802	13.167	1.623	0.374	0	0	0	38.709
	N Caught	0	0	0	0	0	0	0	0	
2004	Tons at Age	95	346	322	59	2	3	0	0	828
	N at Age	2.161	6.319	5.322	0.861	0.038	0	0	0	14.743
	N Caught	0	0	0	0	0	0	0	0	

WOLLOCHET BAY STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
2000	Tons at Age	45	82	10	3	2	0	0	0	142
	N at Age	0.851	1.226	0.102	0.023	0.011	0	0	0	2.213
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	59	52	22	0	0	0	0	0	133
	N at Age	1.528	0.719	0.225	0.000	0.000	0	0	0	2.472
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	23	56	19	5	3	0	0	0	106
	N at Age	0.564	1.073	0.200	0.036	0.018	0	0	0	1.891
	N Caught	0	0	0	0	0	0	0	0	
2003	no age data									152
2004	no age data									52

QUARTERMASTER HARBOR STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
1995	Tons at Age	1433	410	146	10	0	0	0	0	2001
	N at Age	26.259	4.952	1.497	0.115	0	0	0	0	32.823
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	477	315	12	0	0	0	0	0	805
	N at Age	8.921	4.401	0.122	0.000	0.000	0	0	0	13.444
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	1147	231	24	0	0	0	0	0	1402
	N at Age	23.909	3.094	0.281	0.000	0.000	0	0	0	27.284
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	287	457	184	19	0	0	0	0	947
	N at Age	4.970	4.970	1.621	0.162	0.000	0	0	0	11.723
	N Caught	0	0	0	0	0	0	0	0	
1999	Tons at Age	1115	106	38	0	0	0	0	0	1257
	N at Age	22.289	1.454	0.363	0.000	0.000	0	0	0	24.106
	N Caught	0	0	0	0	0	0	0	0	
2000	Tons at Age	171	556	16	0	0	0	0	0	743
	N at Age	2.884	8.254	0.199	0.000	0.000	0	0	0	11.337
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	198	1044	78	0	0	0	0	0	1320
	N at Age	3.888	14.176	0.729	0.000	0.000	0	0	0	18.793
	N Caught	0	0	0	0	0	0	0	0	

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	
2002	Tons at Age	41	206	167	2	0	0	0	0	416
	N at Age	0.933	2.736	1.741	0.031	0.000	0	0	0	5.441
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	150	541	179	60	0	0	0	0	930
	N at Age	3.809	10.093	2.666	0.667	0.000	0	0	0	17.235
	N Caught	0	0	0	0	0	0	0	0	
2004	Tons at Age	40	186	252	189	32	27	0	0	727
	N at Age	1.003	3.364	3.186	2.006	0.295	0	0	0	10.090
	N Caught	0	0	0	0	0	0	0	0	

PORT ORCHARD/MADISON STOCK

YEAR		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
1988	Tons at Age	431	839	358	36	29	12	0	0	1705
	N at Age	6.807	8.95	2.906	0.293	0.208	0.061	0	0	19.225
	N Caught	0	0	0	0	0	0	0	0	
1989	Tons at Age	670	466	496	108	0	0	0	0	1739
	N at Age	12.009	4.945	4.588	0.782	0.05	0.05	0	0	
	N Caught	0.609	0.251	0.233	0.4	0	0	0	0	
1990	Tons at Age	766	648	174	127	59	22	0	0	1795
	N at Age	15.137	7.943	1.494	0.997	0.409	0.119	0	0	26.099
	N Caught	0	0	0	0	0	0	0	0	
1991	Tons at Age	380	146	118	18	47	12	1	0	722
	N at Age	8.013	2.054	1.231	0.152	0.416	0.078	0.015	0	11.959
	N Caught	0	0	0	0	0	0	0	0	
1992	Tons at Age	156	116	30	9	2	1	0	0	314
	N at Age	3.343	1.679	0.294	0.058	0.011	0.005	0	0	5.390
	N Caught	0	0	0	0	0	0	0	0	
1993	Tons at Age	266	16	15	3	4	0	0	0	304
	N at Age	4.988	0.19	0.148	0.025	0.019	0	0	0	5.370
	N Caught	0	0	0	0	0	0	0	0	
1994	Tons at Age	198	192	22	11	0	0	0	0	424
	N at Age	3.249	2.284	0.182	0.079	0	0	0	0	5.794
	N Caught	0	0	0	0	0	0	0	0	
1995	Tons at Age	619	165	79	0	0	0	0	0	863
	N at Age	11.988	1.87	0.683	0	0	0	0	0	14.541
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	429	310	63	4	0	0	0	0	806
	N at Age	8.27	4.297	0.631	0.025	0	0	0	0	13.223
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	214	130	14	2	0	0	0	0	360
	N at Age	4.226	1.645	0.126	0.012	0	0	0	0	6.009
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	381	87	16	5	0	0	0	0	489
	N at Age	8.156	1.304	0.146	0.04	0	0	0	0	9.646
	N Caught	0	0	0	0	0	0	0	0	
1999	Tons at Age	1765	187	32	22	0	0	0	0	2006
	N at Age	37.913	2.542	0.339	0.017	0	0	0	0	40.811
	N Caught	0	0	0	0	0	0	0	0	
2000	Tons at Age	592	1110	53	2	0	0	0	0	1756
	N at Age	11.406	17.808	0.673	0.017	0	0	0	0	29.904
	N Caught	0	0	0	0	0	0	0	0	

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age5	Age 6	Age 7	Age 8	GTE Age 9	
2001	Tons at Age	1158	682	157	10	0	0	0	0	2007
	N at Age	27.825	9.793	1.587	0.075	0	0	0	0	39.280
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	268	525	56	15	14	0	0	0	878
	N at Age	6.632	8.733	0.745	0.149	0.108	0	0	0	16.367
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	283	522	228	48	4	1	0	0	1085
	N at Age	7.031	9.783	3.095	0.486	0.040	0.010	0	0	20.445
	N Caught	0	0	0	0	0	0	0	0	
2004	Tons at Age	116	366	169	48	0	0	0	0	700
	N at Age	2.616	5.948	2.078	0.509	0.006	0.003	0	0	11.160
	N Caught	0	0	0	0	0	0	0	0	

PORT GAMBLE STOCK

YEAR		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
1976	Tons at Age	58	453	381	86	71	65	13	15	1142
	N at Age	0.866	4.425	2.809	0.548	0.414	0.404	0.058	0.096	9.62
	N Caught									
1977	no age data									2525
1978	Tons at Age	87	270	389	421	403	252	103	60	1984
	N at Age	1.170	2.352	2.465	2.415	2.201	1.220	0.491	0.264	12.578
	N Caught									
1979	Tons at Age	0	548	360	523	179	181	0	0	1790
	N at Age	0.000	4.460	2.286	2.779	0.840	0.840	0.000	0.000	11.206
	N Caught									
1980	no age data									2309
1981	Tons at Age	221	633	380	307	138	47	28	0	1753
	N at Age	2.897	5.409	2.419	1.595	0.598	0.226	0.133	0.000	13.290
	N Caught									
1987	Tons at Age	935	820	256	35	0	0	0	0	2046
	N at Age	14.535	8.479	2.2	2.33	0	0	0	0	27.544
	N Caught	0.078	0.046	0.012	0.001	0	0	0	0	0.137
1988	Tons at Age	461	713	178	36	0	0	0	0	1390
	N at Age	6.159	6.644	1.319	0.243	0	0	0	0	14.365
	N Caught	0.142	0.153	0.03	0.006	0	0	0	0	0.331
1989	Tons at Age	1339	532	371	153	0	0	0	0	2395
	N at Age	22.302	5.582	3.122	1.119	0	0	0	0	32.125
	N Caught	0.133	0.033	0.019	0.007	0	0	0	0	0.192
1990	Tons at Age	965	1155	606	178	65	0	0	0	2969
	N at Age	15.678	11.974	4.457	1.127	0.376	0	0	0	33.612
	N Caught	0.454	0.347	0.129	0.033	0.011	0	0	0	0.974
1991	Tons at Age	380	915	630	194	104	36	0	0	2259
	N at Age	6.695	10.226	5.677	1.482	0.751	0.22	0	0	25.051
	N Caught	0.265	0.404	0.224	0.059	0.03	0.009	0	0	0.991
1992	Tons at Age	454	1251	454	79	30	0	0	0	2270
	N at Age	6.693	13.44	3.882	0.615	0.2	0	0	0	24.83
	N Caught	0.007	0.013	0.004	0.001	0	0	0	0	0.025
1993	Tons at Age	922	365	183	35	15	0	0	0	1521
	N at Age	18.052	4.107	1.7	0.263	0.098	0	0	0	24.22

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	
	N Caught	0.012	0.003	0.001	0	0	0	0	0	0.016
1994	Tons at Age	1054	986	569	206	40	0	0	0	2857
	N at Age	15.975	10.981	4.834	1.46	0.236	0	0	0	33.486
	N Caught	0	0	0	0	0	0	0	0	0
1995	Tons at Age	1964	742	344	92	13	0	0	0	3158
	N at Age	35.324	8.22	2.968	0.692	0	0.057	0	0	47.261
	N Caught	0	0	0	0	0	0	0	0	0
1996	Tons at Age	805	903	315	37	0	0	0	0	2058
	N at Age	13.915	11.325	2.932	0.289	0	0	0	0	28.461
	N Caught	0	0	0	0	0	0	0	0	0
1997	Tons at Age	844	473	77	26	0	0	0	0	1419
	N at Age	13.555	4.741	0.578	0.127	0	0	0	0	19.001
	N Caught	0	0	0	0	0	0	0	0	0
1998	Tons at Age	257	486	208	7	13	0	0	0	971
	N at Age	5.013	6.61	2.044	0.05	0.073	0	0	0	13.79
	N Caught	0	0	0	0	0	0	0	0	0
1999	Tons at Age	917	582	148	17	0	0	0	0	1664
	N at Age	17.476	7.909	1.531	0.128	0	0	0	0	27.044
	N Caught	0	0	0	0	0	0	0	0	0
2000	Tons at Age	890	1338	182	34	12	0	0	0	2459
	N at Age	17.448	20.304	2.091	0.377	0.121	0	0	0	40.341
	N Caught	0	0	0	0	0	0	0	0	0
2001	Tons at Age	585	1035	148	11	0	0	0	0	1779
	N at Age	9.328	11.749	1.353	0.071	0	0	0	0	22.501
	N Caught	0	0	0	0	0	0	0	0	0
2002	Tons at Age	313	1058	393	49	0	0	0	0	1812
	N at Age	5.91	13.557	3.939	0.348	0	0	0	0	23.754
	N Caught	0	0	0	0	0	0	0	0	0
2003	Tons at Age	184	621	231	29	0	0	0	0	1064
	N at Age	5.91	13.557	3.939	0.348	0	0	0	0	23.754
	N Caught	0	0	0	0	0	0	0	0	0
2003	no age data									1064
2004	no age data									1257

KILISUT HARBOR STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
1994	Tons at Age	81	149	17	46	0	0	0	0	292
	N at Age	1.176	1.554	0.126	0.252	0	0	0	0	3.108
	N Caught	0	0	0	0	0	0	0	0	0
1996	Tons at Age	279	83	18	0	0	0	0	0	380
	N at Age	4.73	0.898	0.132	0	0	0	0	0	5.76
	N Caught	0	0	0	0	0	0	0	0	0
1997	Tons at Age	123	103	64	17	0	0	0	0	307
	N at Age	1.688	1.019	0.478	0.096	0.000	0	0	0	3.281
	N Caught	0	0	0	0	0	0	0	0	0
1998	Tons at Age	97	133	72	6	3	0	0	0	311
	N at Age	1.683	1.557	0.609	0.054	0.018	0	0	0	3.921
	N Caught	0	0	0	0	0	0	0	0	0
1999	Tons at Age	768	26	7	0	0	0	0	0	802

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	
	N at Age	16.939	0.434	0.059	0.000	0.000	0	0	0	17.432
	N Caught	0	0	0	0	0	0	0	0	
2000	Tons at Age	90	17	0	0	0	0	0	0	107
	N at Age	2.084	0.250	0.000	0.000	0.000	0	0	0	2.334
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	214	348	43	7	0	0	0	0	612
	N at Age	4.065	4.286	0.385	0.050	0.000	0	0	0	8.786
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	165	527	75	7	0	0	0	0	774
	N at Age	2.428	6.555	0.810	0.081	0.000	0	0	0	9.874
	N Caught	0	0	0	0	0	0	0	0	
2003	no age data									448
2004	Tons at Age	39	125	18	2	0	0	0	0	184
	N at Age	1.925	0.578	0.252	0.252	0.074	0.015	0	0	3.096
	N Caught	0	0	0	0	0	0	0	0	

PORT SUSAN STOCK

YEAR		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
1995	Tons at Age	176	122	60	5	0	0	0	0	363
	N at Age	2.643	1.144	0.483	0.025	0	0	0	0	4.295
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	36	58	16	0	0	0	0	0	110
	N at Age	0.548	0.644	0.137	0.000	0.000	0	0	0	1.329
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	198	524	96	10	0	0	0	0	828
	N at Age	2.884	5.438	0.824	0.082	0.000	0	0	0	9.228
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	279	1202	565	38	0	0	0	0	2084
	N at Age	5.127	15.227	5.438	0.311	0.000	0	0	0	26.103
	N Caught	0	0	0	0	0	0	0	0	
1999	no age data									545
2000	Tons at Age	166	428	184	6	0	0	0	0	785
	N at Age	2.665	5.552	1.926	0.051	0.000	0	0	0	10.194
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	357	207	23	0	0	0	0	0	587
	N at Age	6.839	2.550	0.232	0.000	0.000	0	0	0	9.621
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	71	353	310	41	0	0	0	0	775
	N at Age	1.384	5.015	3.517	0.404	0.000	0	0	0	10.32
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	85	298	53	14	0	0	0	0	450
	N at Age	2.219	4.851	0.721	0.155	0.000	0	0	0	7.946
	N Caught	0	0	0	0	0	0	0	0	
2004	Tons at Age	74	144	152	51	7	0	0	0	429
	N at Age	1.556	2.413	2.063	0.623	0.078	0	0	0	6.733
	N Caught	0	0	0	0	0	0	0	0	

HOLMES HARBOR STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
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Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age5	Age 6	Age 7	Age 8	GTE Age 9	
YEAR										
1996	Tons at Age	230	68	38	0	0	0	0	0	336
	N at Age	4.479	0.817	0.328	0	0	0	0	0	5.624
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	277	200	52	0	0	0	0	0	530
	N at Age	5.256	2.471	0.470	0.000	0.000	0	0	0	8.197
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	134	166	128	26	12	0	0	0	464
	N at Age	3.052	2.616	1.134	0.174	0.087	0	0	0	7.063
	N Caught	0	0	0	0	0	0	0	0	
1999	no age data									175
2000	no age data									281
2001	no age data									275
2002	no age data									573
2003	no age data									678
2004	no age data									673

SKAGIT BAY STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
1995	Tons at Age	257	366	267	0	0	0	0	0	891
	N at Age	3.739	3.49	2.243	0	0	0	0	0	9.472
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	629	107	0	0	0	0	0	0	736
	N at Age	13.718	1.407	0.000	0.000	0.000	0	0	0	15.125
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	791	101	0	0	0	0	0	0	892
	N at Age	18.055	1.509	0.000	0.000	0.000	0	0	0	19.564
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	127	62	20	0	0	0	0	0	209
	N at Age	3.031	1.023	0.218	0.000	0.000	0	0	0	4.272
	N Caught	0	0	0	0	0	0	0	0	
1999	no age data									905
2000	Tons at Age	464	161	21	0	0	0	0	0	646
	N at Age	10.040	2.584	0.262	0.000	0.000	0	0	0	12.886
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	688	1243	226	13	0	0	0	0	2170
	N at Age	12.820	15.768	2.143	0.095	0.000	0	0	0	30.826
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	465	1108	576	66	0	0	0	0	2215
	N at Age	9.403	16.494	6.937	0.616	0.000	0	0	0	33.45
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	1199	1426	331	27	0	0	0	0	2983
	N at Age	30.342	24.875	4.641	0.236	0.000	0	0	0	60.094
	N Caught	0	0	0	0	0	0	0	0	
2004	Tons at Age	300	646	238	47	7	6	0	0	1245
	N at Age	6.915	11.927	3.742	0.702	0.081	0	0	0	23.448
	N Caught	0	0	0	0	0	0	0	0	

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	
FIDALGO BAY STOCK										
YEAR		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
1992	Tons at Age	270	767	269	81	13	0	0	0	1399
	N at Age	6.987	13.581	3.641	1.083	0.197	0	0	0	25.489
	N Caught	0	0	0	0	0	0	0	0	
1993	Tons at Age	894	356	128	26	14	0	0	0	1417
	N at Age	19.706	6.031	1.699	0.17	0.085	0	0	0	27.691
	N Caught	0	0	0	0	0	0	0	0	
1994	Tons at Age	548	454	153	45	6	0	0	0	1207
	N at Age	10.43	7.327	2.111	0.487	0.103	0	0	0	20.458
	N Caught	0	0	0	0	0	0	0	0	
1995	Tons at Age	772	240	106	27	28	0	0	0	1173
	N at Age	19.078	4.101	1.426	0.357	0.357	0	0	0	25.319
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	210	291	74	15	0	0	0	0	590
	N at Age	4.792	4.250	0.995	0.090	0.000	0	0	0	10.127
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	543	301	85	0	0	0	0	0	929
	N at Age	14.166	4.481	0.723	0.000	0.000	0	0	0	19.370
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	500	284	43	18	0	0	0	0	844
	N at Age	11.006	4.442	0.464	0.133	0.000	0	0	0	16.045
	N Caught	0	0	0	0	0	0	0	0	
1999	no age data									1005
2000	Tons at Age	404	300	18	15	0	0	0	0	737
	N at Age	8.320	4.530	0.277	0.185	0.000	0	0	0	13.312
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	169	569	171	35	0	0	0	0	944
	N at Age	3.310	8.851	1.924	0.308	0.000	0	0	0	14.393
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	593	165	91	15	0	0	0	0	865
	N at Age	14.214	2.496	0.977	0.109	0.000	0	0	0	17.796
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	48	254	164	94	8	0	0	0	569
	N at Age	1.004	4.319	2.008	0.703	0.100	0	0	0	8.134
	N Caught	0	0	0	0	0	0	0	0	
2004	no age data									339
SAMISH/PORTAGE BAY STOCK										
YEAR		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
1994	Tons at Age	348	88	18	4	0	0	0	0	459
	N at Age	6.599	1.245	0.244	0.032	0	0	0	0	8.120
	N Caught	0	0	0	0	0	0	0	0	
1995	Tons at Age	128	39	21	6	0	0	0	0	194
	N at Age	2.611	0.5	0.231	0.067	0	0	0	0	3.409
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	259	333	44	0	0	0	0	0	636

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	
	N at Age	4.336	4.336	0.417	0.000	0.000	0	0	0	9.089
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	310	165	30	4	0	0	0	0	509
	N at Age	6.203	1.948	0.253	0.035	0.000	0	0	0	8.439
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	284	286	72	0	0	0	0	0	643
	N at Age	6.525	5.171	0.985	0.000	0.000	0	0	0	12.681
	N Caught	0	0	0	0	0	0	0	0	
1999	no age data									555
2000	no age data									196
2001	Tons at Age	255	173	41	0	0	0	0	0	470
	N at Age	4.871	2.389	0.375	0.000	0.000	0	0	0	7.635
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	194	203	71	22	5	0	0	0	496
	N at Age	4.591	3.549	0.899	0.190	0.047	0	0	0	9.276
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	20	109	98	56	12	0	5	0	299
	N at Age	0.437	1.598	1.046	0.513	0.076	0.000	0.038	0.000	3.708
	N Caught	0	0	0	0	0	0	0	0	
2004	no age data									351

INTERIOR SAN JUAN ISLANDS STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
1993	Tons at Age	343	107	23	0	0	0	0	0	472
	N at Age	6.438	1.231	0.189	0	0	0	0	0	7.858
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	113	137	23	4	0	0	0	0	277
	N at Age	2.378	2.201	0.276	0.031	0	0	0	0	4.886
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	30	0	0	0	0	0	0	0	30
	N at Age	0.677	0.000	0.000	0.000	0.000	0	0	0	0.677
	N Caught	0	0	0	0	0	0	0	0	
1998	no age data									
1999	no age data									197
2000	Tons at Age	112	16	0	0	0	0	0	0	128
	N at Age	2.798	0.289	0.000	0.000	0.000	0	0	0	3.087
	N Caught	0	0	0	0	0	0	0	0	
2001	no age data									219
2002	no age data									158
2003	no age data									72
2004	no age data									67

SEMIAMMOO BAY STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
1988	Tons at Age	664	1063	189	49	0	0	0	0	1965

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	
	N at Age	9.508	10.914	1.406	0.335	0	0	0	0	22.163
	N Caught	0	0	0	0	0	0	0	0	
1989	Tons at Age	655	583	396	48	19	0	0	0	1701
	N at Age	10.89	5.954	3.081	0.32	0.134	0	0	0	20.379
	N Caught	0	0	0	0	0	0	0	0	
1990	Tons at Age	1330	380	116	75	29	0	0	0	1930
	N at Age	25.239	5.013	0.994	0.54	0.195	0	0	0	31.981
	N Caught	0	0	0	0	0	0	0	0	
1991	Tons at Age	1164	536	155	136	70	0	0	0	2061
	N at Age	21.772	6.887	1.555	0.889	0.444	0	0	0	31.547
	N Caught	0	0	0	0	0	0	0	0	
1992	Tons at Age	417	729	207	81	41	14	12	0	1501
	N at Age	7.716	8.901	1.819	0.56	0.251	0.063	0.063	0	19.373
	N Caught	0	0	0	0	0	0	0	0	
1993	Tons at Age	1390	268	164	63	10	6	0	0	1902
	N at Age	25.266	3.201	1.485	0.439	0.061	0.045	0	0	30.497
	N Caught	0	0	0	0	0	0	0	0	
1994	Tons at Age	870	367	119	18	14	0	0	0	1389
	N at Age	14.375	4.231	1.114	0.15	0.077	0	0	0	19.947
	N Caught	0.0000	0.0001	0.0010	0.0003	0.0008	0	0	0	
1996	Tons at Age	688	423	87	17	5	0	0	0	1219
	N at Age	12.746	4.869	0.654	0.123	0	0.033	0	0	18.425
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	297	260	50	13	0	0	0	0	621
	N at Age	5.88	2.973	0.387	0	0.062	0	0	0	9.302
	N Caught	0	0	0	0	0	0	0	0	
1998	Tons at Age	601	230	74	16	0	0	0	0	919
	N at Age	14.121	3.896	0.852	0.122	0	0	0	0	18.991
	N Caught	0	0	0	0	0	0	0	0	
1999	no age data									868
2000	Tons at Age	793	126	7	0	0	0	0	0	926
	N at Age	16.063	1.866	0.08	0	0	0	0	0	18.009
	N Caught	0	0	0	0	0	0	0	0	
2001	no age data									1098
2002	no age data									1012
2003	no age data									1087
2004	no age data									629

CHERRY POINT STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
1973	Tons at Age	15	765	5864	4649	2880	645	90	0	14998
	N at Age	0.163	7.562	35.128	22.768	12.523	2.765	0.407	0.000	81.315
	N Caught	0.022	1.013	4.816	3.249	1.566	0.321	0.053	0	
1974	Tons at Age	42	1690	2430	4761	3281	1466	251	28	13963
	N at Age	0.542	23.213	16.619	26.284	15.897	6.594	0.994	0.090	90.322
	N Caught	0.025	1.331	3.593	9.236	6.773	2.715	0.34	0.084	

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age5	Age 6	Age 7	Age 8	GTE Age 9	
1975	Tons at Age	10	1954	1003	1923	3039	1819	538	52	10337
	N at Age	0.162	15.416	6.091	9.271	13.584	7.277	1.994	0.162	53.903
	N Caught	0.027	2.847	2.141	4.206	5.949	2.937	0.742	0.049	
1976	Tons at Age	379	794	2854	1587	2132	2653	1137	308	11844
	N at Age	5.528	10.169	18.087	8.327	9.828	11.057	4.368	1.229	68.251
	N Caught	0.535	1.014	3.415	1.922	2.136	2.173	0.703	0.195	
1977	Tons at Age	932	2486	843	1409	1065	1609	1665	1088	11097
	N at Age	13.912	22.406	6.151	7.908	5.199	6.810	6.663	4.100	73.221
	N Caught	0.826	1.568	2.394	2.003	2.052	1.768	0.965	0.429	
1978	Tons at Age	77	4521	1920	878	944	636	834	1174	10973
	N at Age	1.237	41.753	14.150	5.026	4.717	2.784	3.402	4.253	77.320
	N Caught	0.117	4.969	2.655	1.343	1.534	0.836	0.817	0.869	
1979	Tons at Age	269	976	3983	1872	747	996	438	687	9957
	N at Age	3.824	8.066	25.751	10.038	3.525	4.242	1.733	2.629	59.748
	N Caught	0.579	1.265	4.45	2.095	1.014	0.909	0.392	0.533	
1980	Tons at Age	3209	690	793	1847	1549	494	345	308	9329
	N at Age	40.156	6.217	5.047	9.948	7.241	2.121	1.317	1.097	73.144
	N Caught	4.897	1.041	1.736	1.822	0.965	0.338	0.154	0.161	
1981	Tons at Age	448	2631	740	647	1188	348	87	131	6219
	N at Age	5.991	20.715	4.894	3.164	5.274	1.392	0.338	0.422	42.189
	N Caught	0	0	0	0	0	0	0	0	
1982	Tons at Age	1261	1122	1747	614	299	230	64	0	5342
	N at Age	16.415	8.957	10.665	3.166	1.292	0.958	0.250	0.000	41.662
	N Caught	0.275	0.764	0.405	0.146	0.127	0.053	0.015	0.001	
1983	Tons at Age	1846	1580	1451	2185	597	161	202	40	8063
	N at Age	24.702	12.504	8.661	10.918	2.623	0.671	0.793	0.183	60.993
	N Caught	0	0	0	0	0	0	0	0	
1984	Tons at Age	1664	779	926	1151	985	242	71	77	5901
	N at Age	23.954	6.494	5.868	5.724	4.425	1.010	0.289	0.289	48.100
	N Caught	0	0	0	0	0	0	0	0	
1985	Tons at Age	1659	2385	1020	271	207	150	40	29	5760
	N at Age	23.895	21.667	6.907	1.448	0.947	0.613	0.167	0.000	55.700
	N Caught	0	0	0	0	0	0	0	0	
1986	Tons at Age	2393	1718	754	414	250	74	51	11	5671
	N at Age	30.802	14.959	5.465	2.208	1.214	0.276	0.221	0.055	55.200
	N Caught	0	0	0	0	0	0	0	0	
1987	Tons at Age	814	1287	622	199	90	37	22	37	3108
	N at Age	12.576	11.026	4.261	1.103	0.447	0.149	0.089	0.119	29.800
	N Caught	0.578	0.523	0.232	0.074	0.03	0.012	0.004	0.008	
1988	Tons at Age	1089	1793	1014	385	111	35	0	4	4428
	N at Age	14.794	16.120	6.593	2.010	0.523	0.161	0.000	0.000	40.200
	N Caught	0.408	0.448	0.194	0.063	0.017	0.004	0	0.001	
1989	Tons at Age	2086	809	745	348	12	8	0	0	4003
	N at Age	34.104	7.889	4.998	1.911	0.049	0.049	0.000	0.000	49.000
	N Caught	1.86	0.441	0.38	0.196	0.003	0.004	0	0	
1990	Tons at Age	1864	1769	450	605	265	25	20	0	4998
	N at Age	27.183	18.389	3.091	3.198	1.279	0.107	0.107	0.000	53.300
	N Caught	1.509	1.024	0.188	0.22	0.091	0.007	0.005	0	
1991	Tons at Age	754	1766	1151	499	398	46	14	0	4624
	N at Age	10.613	16.758	7.820	2.673	1.796	0.200	0.040	0.000	39.900
	N Caught	0.545	0.871	0.451	0.175	0.121	0.013	0.004	0	

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age5	Age 6	Age 7	Age 8	GTE Age 9	
1992	Tons at Age	1527	850	1119	349	88	60	8	0	4009
	N at Age	23.758	8.288	7.820	1.955	0.383	0.255	0.043	0.000	42.500
	N Caught	1.05	0.369	0.382	0.109	0.022	0.015	0.002	0	
1993	Tons at Age	3475	626	299	240	171	69	10	0	4894
	N at Age	55.342	6.767	2.211	1.407	0.871	0.268	0.067	0.000	67.000
	N Caught	3.179	0.392	0.152	0.121	0.092	0.029	0.006	0	
1994	Tons at Age	4876	873	304	133	114	19	6	0	6324
	N at Age	73.725	9.248	2.161	0.691	0.519	0.086	0.000	0.000	86.430
	N Caught	3.695	0.47	0.156	0.076	0.049	0.007	0.003	0	
1995	Tons at Age	1519	1942	320	99	189	33	4	0	4105
	N at Age	20.262	18.080	2.223	0.503	0.713	0.126	0.000	0.000	41.950
	N Caught	1.514	1.362	0.204	0.069	0.094	0.014	0.002	0	
1996	Tons at Age	573	1111	1083	204	53	68	6	0	3095
	N at Age	8.654	10.789	7.789	1.125	0.202	0.288	0.029	0.000	28.847
	N Caught	0.359	0.45	0.343	0.059	0.009	0.013	0.001	0	
1997	Tons at Age	236	630	595	82	33	0	0	0	1574
	N at Age	3.856	6.051	4.360	0.445	0.133	0.000	0.000	0.000	14.830
	N Caught	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
1998	Tons at Age	841	205	196	59	21	0	0	0	1322
	N at Age	13.064	2.143	1.361	0.323	0.119	0.000	0.000	0.000	17.010
	N Caught	0	0	0	0	0	0	0	0	
1999	Tons at Age	267	884	82	29	4	0	0	0	1266
	N at Age	4.183	9.129	0.650	0.155	0.014	0.000	0.000	0.000	14.131
	N Caught	0	0	0	0	0	0	0	0	
2000	Tons at Age	370	249	185	3	0	0	0	0	808
	N at Age	5.221	2.514	1.413	0.018	0.000	0.000	0.000	0.000	9.175
	N Caught	0	0	0	0	0	0	0	0	
2001	Tons at Age	374	565	247	56	0	0	0	0	1241
	N at Age	5.592	6.434	1.897	0.328	0.000	0.000	0.000	0.000	14.265
	N Caught	0	0	0	0	0	0	0	0	
2002	Tons at Age	646	430	174	37	43	0	0	0	1330
	N at Age	11.173	5.202	1.520	0.220	0.220	0.000	0.000	0.000	18.317
	N Caught	0	0	0	0	0	0	0	0	
2003	Tons at Age	838	596	122	42	13	0	0	0	1611
	N at Age	14.411	7.876	1.245	0.311	0.072	0.000	0.000	0.000	23.939
	N Caught	0	0	0	0	0	0	0	0	
2004	Tons at Age	23	388	740	406	101	54	23	0	1734
	N at Age	0.375	4.168	5.717	2.668	0.584	0.264	0.107	0.000	13.894
	N Caught	0	0	0	0	0	0	0	0	

DISCOVERY BAY STOCK

		Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	GTE Age 9	TOTAL SPAWNER BIOMASS
YEAR										
1976	Tons at Age	1	59	270	100	86	123	38	21	697
	N at Age	0.014	0.602	2.113	0.579	0.466	0.635	0.184	0.108	4.706
	N Caught	0	0	0	0	0	0	0	0	
1977	Tons at Age	88	312	268	317	149	192	97	67	1488
	N at Age	1.165	3.088	2.058	2.070	0.939	1.108	0.532	0.339	11.310
	N Caught	0	0	0	0	0	0	0	0	

Appendix A. (cont.)

		Age 2	Age 3	Age 4	Age5	Age 6	Age 7	Age 8	GTE Age 9	
1978	Tons at Age	0	0	0	0	0	0	0	0	1305
	N at Age	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	N Caught	0	0	0	0	0	0	0	0	
1979	Tons at Age	71	116	132	159	89	173	102	42	882
	N at Age	0.891	1.102	0.972	1.009	0.551	0.922	0.539	0.210	6.190
	N Caught	0	0	0	0	0	0	0	0	
1980	Tons at Age	1877	763	274	71	119	52	58	0	3220
	N at Age	25.405	7.703	2.111	0.518	0.778	0.259	0.259	0.000	37.034
	N Caught	0	0	0	0	0	0	0	0	
1981	Tons at Age	61	1243	614	328	347	316	101	61	3070
	N at Age	0.975	10.866	4.333	2.155	1.951	1.701	0.476	0.250	22.685
	N Caught	0	0	0	0	0	0	0	0	
1988	Tons at Age	536	263	55	0	0	0	0	0	853
	N at Age	7.640	2.670	0.400	0.000	0.000	0	0	0	
	N Caught	0	0	0	0	0	0	0	0	
1996	Tons at Age	431	290	28	5	0	0	0	0	752
	N at Age	6.65	3.172	0.191	0.038	0	0	0	0	10.051
	N Caught	0	0	0	0	0	0	0	0	
1997	Tons at Age	176	23	0	0	0	0	0	0	199
	N at Age	4.335	0.360	0.003	0.000	0.000	0	0	0	4.698
	N Caught	0	0	0	0	0	0	0	0	
1998	no age data									0
1999	no age data									307
2000	no age data									159
2001	no age data									137
2002	no age data									148
2003	no age data									207
2004	no age data									252



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